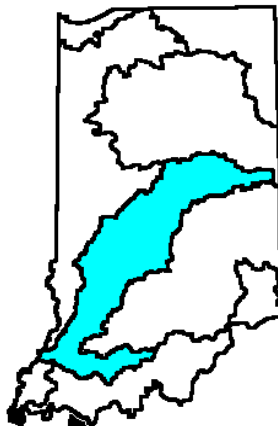
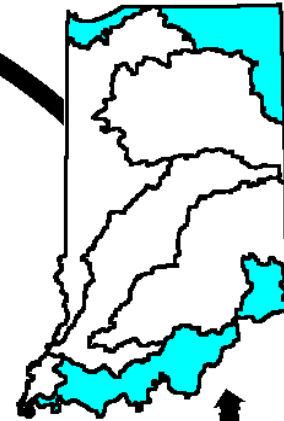


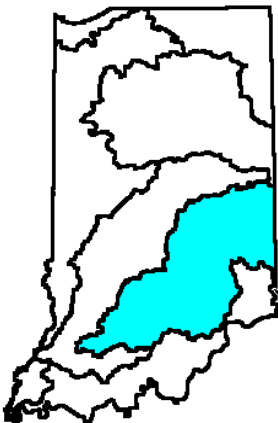
Surface Water Quality MONITORING STRATEGY 1996 - 2000 Revised May 1998



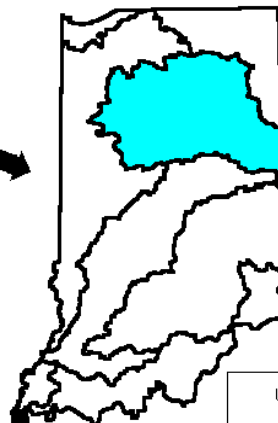
West Fork White River-
Patoka River Basins
1996



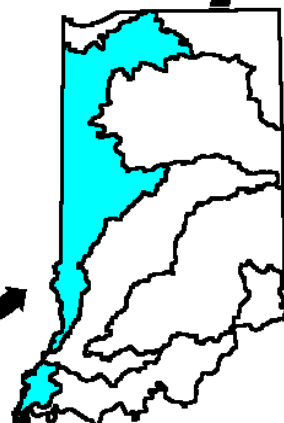
Great Lakes - Ohio
River Basin
2000



East Fork White River-
Whitewater River Basins
1997



Upper Wabash
River Basin
1998



Lower Wabash River-
Kankakee River Basins
1999

Assessment Branch
Office of Water Management
Indiana Department of Environmental Management

IDEM 32/01/013

Surface Water Quality Monitoring Strategy

Indiana Department of Environmental Management
Office of Water Management
Assessment Branch
IDEM 32/01/013/1998
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Executive Summary

The purpose of Office of Water Management's Surface Water Quality Monitoring Strategy is to direct the assessment of the quality of surface waters of Indiana's rivers, streams, and lakes for designated water uses. The strategy is designed to provide technical data and information in support of the biennial 305(b) Water Quality Report, National Pollutant Discharge Elimination System (NPDES) permitting program, and the annual Fish Consumption Advisory¹. In addition, the implemented strategy provides water quality information to identify activities responsible for impairment, analyze water quality trends, and develop environmental indicators.

The State is divided geographically into major units for environmental sampling, analysis, and assessment with the goal of completing an initial survey of the State during the five year period of 1996-2000:

- P West Fork White River and Patoka River Basins in 1996;
- P East Fork White River and Whitewater River Basins in 1997;
- P Upper Wabash River Basin in 1998;
- P Lower Wabash River and Kankakee River Basins in 1999; and
- P Great Lakes and Ohio River Basins in 2000.

The design strategy includes the sampling and analysis of each basin to be conducted once every five years. Data collected from field sampling are analyzed for physical, chemical, and biological factors.

The Office of Water Management's (OWM) field sampling strategy is designed to describe the overall environmental quality of each major river basin and to identify what parts of the river basins are impaired or do not meet water quality standards. Elements of the sampling program include: fixed station monitoring; sampling from statistically selected sites; fish community, fish tissue, and sediment contaminant sampling programs; pesticide monitoring; bacteriological (*E. coli*) sampling; macroinvertebrate sampling; site specific sampling in support of NPDES permitting program; and special projects such as trace metals, Total Maximum Daily Loads (TMDL) sampling, Wildcat Creek Pilot Project, and monitoring of the White River in Marion County.

Staff resources to implement this strategy currently are at 28 full time positions funded by US EPA grants and by discharge permit fees. In addition, college students from the Governor's Public Service Internship Program are used each summer to assist the Assessment Branch in field sampling operations. Volunteer monitoring will be employed to supplement existing IDEM staff whenever applicable.

¹ The Fish Consumption Advisory is produced in conjunction with Indiana Department of Health and the Indiana Department of Natural Resources.

The water quality data will be collected, analyzed, and assessed with information published in multiple formats to be used by a variety of customers. OWM's internal program support activities include: 305(b) Water Quality Report; 303(d) Impaired Water Bodies List; TMDL determinations; and NPDES permits. External uses of monitoring data and information include: the annual Fish Consumption Advisory; the IDEM-U.S. EPA Environmental Performance Partnership Agreement; Northwest Indiana Remedial Action Plan; and the Wildcat Creek Watershed Pilot Project. Access to collected data and information will be provided to the public upon request and via the Internet.

I. Introduction

The Surface Water Quality Monitoring Strategy (hereinafter referred to as the *Strategy*) was originally developed in 1995 by the Indiana Department of Environmental Management (IDEM) Office of Water Management - Assessment Branch and has been revised for 1998 and beyond. This document provides basic information on how the IDEM continues to examine the surface waters of the State. This strategy consists of:

- P dividing the State geographically into major sampling units;
- P field sampling and monitoring for each of the sampling units; and
- P data analysis/assessment of field sampling results.

The *Strategy* is composed of the planning, sampling, and reporting strategies which are discussed in Section II. Additionally, information about the Assessment Branch's resources are provided in Section III. A discussion of the *Strategy* is in Section IV.

Vision

Provide water quality information and develop environmental indicators that provide the information necessary to protect human health and natural resources in all Indiana river basins.

Mission

Implement a surface water quality monitoring strategy that assesses the quality of Indiana surface water resources, the ability to measure support of designated uses, and effectively communicate this information to our internal and external customers.

Goals

1. Measure the physical, chemical, bacteriological, and biological quality of the aquatic environment in all river basins and identify factors responsible for impairment.
2. Assess the impact of human or other activities that occur in all river basins and the probable effects of these activities on drinking water source protection and on the quality of the dynamic ecosystem.
3. Identify trends through analysis of environmental data from a variety of sources and make recommendations for the protection of designated uses of the water resources of the State.

4. Provide environmental quality assessment reports to support the water quality management program in partnership with customers and stakeholders.

A. Background and History

Indiana has a long history of concern for the environment, particularly in the area of water quality. The Industrial Age has brought significant changes to the water quality in Indiana. Concern for water quality in the State was initially driven by public health concerns. In the early 1960s this concern was primarily driven by the obvious need for industries and municipalities to install wastewater treatment facilities to clean up significant point source pollution problems in Indiana rivers, streams, and lakes. As the twenty-first century approaches, these major point source water quality problems are being addressed by current water quality standards and regulations. The role of regulatory agencies such as IDEM has become one of pollution prevention, planning, monitoring, assessment, evaluation, permitting, compliance, and enforcement.

As major point source improvements have been achieved in Indiana and across the nation, it has become apparent that if the goals of the Clean Water Act are to be achieved, more subtle and diffuse sources of pollution, such as nonpoint source pollution, must also be addressed. Recent efforts on the part of the IDEM and the U.S. Environmental Protection Agency (EPA) have focused in assessing nonpoint source pollution by investigating Total Maximum Daily Loads (TMDLs) and performing load allocations attributable to nonpoint source pollution as well as wasteload allocations from point source pollution.

In 1995 the Assessment Branch from the IDEM's Office of Water Management (OWM) developed a proactive monitoring strategy, called the *Office of Water Management's Monitoring Strategy*, for the surface waters of Indiana. This strategy, supported by the 1994 IDEM Strategic Plan, provided guidance and direction in achieving the major goal of enhanced water quality in the State.²

Key elements of the 1995 Monitoring Strategy included strategies for planning, sampling, reporting, and volunteer monitoring. The 1995 Monitoring Strategy included: a) dividing the State geographically into major hydrological groupings or river basins; b) two years of field sampling and monitoring for each of the defined river basins; and c) data analysis/assessment of field sampling results in support of the agency's NPDES permitting program and significant contributions to updating the biennial 305(b) Report on Water Quality to the U.S. EPA. Both the

² This report focuses on surface water only; the ground water monitoring strategy is being developed by the Drinking Water Branch, OWM. IDEM's Strategic Plan has been superseded by the Agency's Environmental Performance Partnership Agreement (EnPPA) with the U. S. EPA.

permitting program and 305(b) Report are mandates that focus on achieving Indiana Water Quality Standards in attainment of designated water uses.

The 1995 Monitoring Strategy was well received throughout the agency and endorsed by the U.S. EPA Region 5 Water Division as being a forward thinking and responsive to meeting the State's water quality objectives. However, for some unforeseen reasons it was not fully implemented in 1996 and 1997. Although the first year general overview (synoptic) surveys were conducted in the West Fork and East Fork of the White River Basin, the second year intensive follow-up field monitoring work was not performed due to staff resource limitations.

B. Rationale for Strategy Revision

The 1995 *Strategy* was developed under the assumption that adequate staff would be available after OWM's 1995 reorganization plan was implemented. Only enough staff were available in 1996 and 1997 to complete the first year activities of the strategy. Of the 43 positions approved in the reorganization, only 28 are currently filled. It is anticipated that several more positions will be filled in the next few months; however, these additional positions will not be enough to conduct both the first and second year work. Therefore, the strategy needs to be revised in order to accomplish as many of the original goals as possible with current resources.

There are other reasons for revising the strategy that have become apparent since its' development. The 1995 *Strategy* did not provide all the data required for the development of wasteload allocations for the NPDES permitting program, and staff were not specifically allocated to gather the additional data. This need has been intensified with IDEM's commitment to process approximately 700 backlogged municipal and industrial permits by June 30, 1999.

Additionally, IDEM has committed to begin TMDL process in 1998. This will require resources to identify sources of impairment, to provide data for modeling and in some cases to monitor water quality after new control measures have been implemented. The 1995 *Strategy* only allocated resources to identify sources of impairment found in the first year work.

The amended Safe Drinking Water Act (SDWA) in 1996 provides that source water protection be emphasized in all watershed planning activities. Thus, when a drinking water intake is located in an area to be sampled, consideration will be given to sampling parameters regulated by the SDWA. This would give an indication of both the current state of the water supply and the susceptibility of the stream for use as a drinking water source in the future.

Finally, the 1995 *Strategy* did not allocate resources for special work that occasionally arises and requires the expertise of the Assessment Branch. One such need in 1998 is for the Trace Metals Pilot Project which supports the Great Lakes Initiative and Triennial Review.

With these reasons in mind, the 1995 *Strategy* is being revised to eliminate the first year synoptic sampling program and to use the resources dedicated to this program to expand the fixed station monitoring program and to create a Special Projects group. This group will be responsible for identifying impairment activities, providing permit and TMDL support, and conducting special projects. While data needs may be greater than current resources can provide, the revised *Strategy* gives the Assessment Branch the flexibility to manage a number of important special project while providing watershed assessments.

C. Basin Monitoring Cycle

One element which remains unchanged from the 1995 *Strategy* is the river basin monitoring cycle. The State of Indiana has been divided geographically into major hydrological groupings or river basins for the purpose of sampling, analysis and assessment. The goal is to conduct the first spatially complete surface water quality survey of the State by the year 2001. The Assessment Branch uses the five year monitoring cycle to conduct sampling in the major basins. The monitoring cycle is listed below according to the year in which the OWM Assessment Branch will conduct sampling activities.

- P West Fork White River and Patoka River Basins in 1996;
- P East Fork White River and Whitewater River Basins in 1997;
- P Upper Wabash River Basin in 1998;
- P Lower Wabash River and Kankakee River Basins in 1999; and
- P Great Lakes and Ohio River Basins in 2000.

D. Support Activities

The vision, mission, and goal statements in the Introduction identify the guiding principles for the *Strategy*. The data will be collected, analyzed, assessed and published in multiple formats and used by a wide variety of customers. Internally, the OWM will use the data for program support activities such as: permitting, section 305(b) assessments, section 303(d) lists, and Total Maximum Daily Load (TMDL) determinations and drinking water source protection activities. IDEM will also use the information produced for agency-wide initiatives, such as: the IDEM-EPA joint Environmental Performance Partnership Agreement (EnPPA), the Northwest Indiana Remedial Action Plan (RAP), and the Wildcat Creek Watershed Pilot Project. Additionally the data, information, and reports produced will be made accessible to the public.

II. Strategy Components

The *Strategy* is composed of three major components: planning, sampling, and reporting. The following sections describe the purpose and process of each component as they provide for comprehensive water quality monitoring, assessment, and communication.

A. Planning

The OWM Assessment Branch programmatic model, as shown in Figure 1, provides a conceptual framework of the branch's activities relative to the study of ecologic stressors and the surface water aquatic ecosystem. A proper conceptual model is fundamental within any ecological assessment.

Historically, the OWM has directed its data collection efforts towards point source control and regulation. This has resulted in gaps in the assessment of the ambient condition of surface waters of the state. IDEM has embarked on a proactive approach using the *Strategy*, which will fill in these data gaps and provide a unified framework from which assessment of the surface waters of the state can be achieved or undertaken. The ecological assessments conducted by the OWM Assessment Branch, involve ongoing measurements of the chemical, physical, bacteriological, and biological systems to determine the ecological integrity of the surface waters of the State.

The OWM Assessment Branch staff collect field and laboratory data (see Figure 2) which are interpreted through the use of various descriptive analytical techniques and developed into environmental indicators. These assessments provide the data and the information which are delivered to numerous customers and stakeholders.

By providing a conceptual framework, a comprehensive monitoring strategy can be designed and effectively implemented. This *Strategy* will provide the comprehensive water quality assessments needed for management decisions, made in partnership with the citizens of Indiana, to protect designated uses of Indiana waters.

SURFACE WATER QUALITY MONITORING STRATEGY

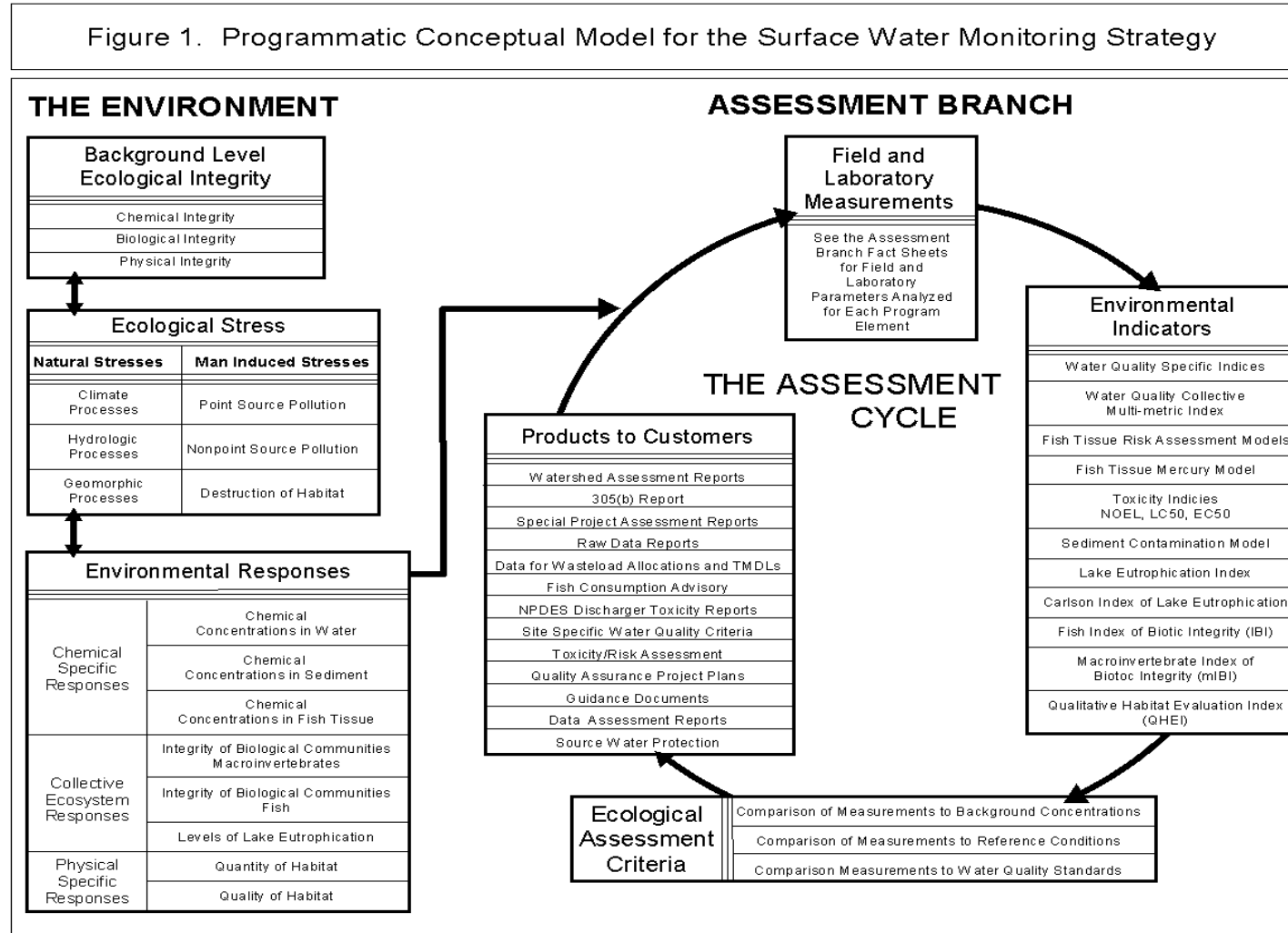







Figure 2: OWM Assessment Branch Functions and Support Activities (Please see program factsheets in the appendices for more information.)

Assessment Branch		Programmatic Functions										
		Describe Existing Conditions and Emerging Problems			Monitor and Evaluate Long Term Trends			Identify Impairment Factors	Data Qualification and Validation	Toxicity/Risk Assessments, Water Quality Criteria Development	Water Quality Assessments	Products
		chemical	biological	physical	chemical	biological	physical					
Surveys and Biological Studies Sections	Watershed* Monitoring Sampling										Statistical analysis and evaluation using environmental indicators (EnPPA and others) Toxicity/risk assessments	# Watershed reports # 305(b) reports to EPA # Special project reports # Raw data reports # Data for Waste Load Allocations and Total Maximum Daily Loads # Fish consumption advisory reports # NPDES discharger reports # Compliance monitoring reports # Toxicity/risk assessment reports # Water Quality Criteria guidance documents # Site specific water quality criteria # Toxicity/risk assessments # Quality Assurance Project Plans # Data assessment reports # Guidance documents # Source Water Protection
	Macro-invertebrate Community Sampling											
	Fixed Station (Ambient) Sampling											
	Special Sampling Projects											
Toxicology and Chemistry Section												

* formerly referred to as Probabilistic Sampling Program

B. Sampling

This design strategy includes the sampling and analysis of each basin to be conducted once every five years according to the *Strategy* planning schedule. Two main objectives are addressed. The first is to describe the overall environmental quality of the water resource in the major river basins. The second is to identify what parts of the river basins are impaired or do not meet water quality standards.

The parameters for sampling include both field analyzed indicators and laboratory analyzed indicators. It is not practical, given resource limitations, to test for all analytes which have Water Quality Standards, so indicators have been chosen to provide the best indication of pollution and impaired water quality. Water chemistry, biological indices, and habitat assessments are evaluated to gain a picture of the overall health of the water resources in each major river basin. When a drinking water intake is located in an area to be sampled, consideration will be given to sampling parameters regulated by the Safe Drinking Water Act.

Results of biological, chemical, and hydrological data will be used to evaluate each river basin separately. Program effectiveness will continue to be evaluated to maximize the utilization of available resources to meet the objectives stated above. The challenge is to communicate technical information in a more timely and accurate way for use in policy making, regulation, and public awareness

The sampling strategy will be an integration of all of the water body sampling, analysis and interpretation programs of the IDEM Office of Water Management's Assessment Branch with the above objectives in mind. It will be based on several separate and collective components which are generated from the Assessment Branch's Biological Studies and Surveys Sections. Most components will be carried out only in the basins when they are targeted every fifth year, while some components will be performed throughout the five year cycle. A summary of the sampling programs within the scope of the *Strategy* is provided in Figure 3. In addition, fact sheets are provided in Appendix A, which describe the sampling program objectives, participants, products and provide technical notes. The following text describes the sampling programs which are currently components of the *Strategy*.

P Fixed Station Sampling Program

This program is currently comprised of 156 sampling sites which are sampled monthly when possible. This increase from the 1995 Monitoring Strategy from 106 sites was a result of the addition of 50 sites in 1998 to enhance coverage spatially on the main stems of the major rivers. Samples will be taken during a variety of stream conditions: high flow, low flow, before agricultural activity, after fertilizer/pesticide application, and after the leaves fall.

P Pesticide Monitoring Program

The main objective of this project is to determine the ambient concentrations of pesticides throughout the major watersheds of Indiana. Loading calculations will be done based on flow data obtained from each site. Sampling sites are selected to focus on main stems of the major watersheds. All sites are located at U.S. Geological Survey gaging stations. Sampling will be performed during the pre-emergent and post-emergent application periods for pesticides during the year. This process will show the seasonal trends associated with nonpoint source runoff. The results of this project will contribute to the 305(b) report, 303(d) list, basin assessment reports, and the 319 nonpoint source priority watershed list.

P Bacteriological Sampling Project

The biological indicator used for this project is *Escherichia coli* (*E. coli*). The main purpose for using this parameter is that it is an indicator which shows the ability of a water body to support recreational uses for full body contact (e.g., swimming) according to Indiana Water Quality Standards. Sampling sites for *E. coli* will be selected based on historical information acquired from conservation officers and county health departments. All sampling sites will be sampled five times per month during the recreational season in order to conform to the requirements of the Indiana Water Quality Standards.

P Watershed Monitoring Program

This program uses a statistically valid number of randomly selected sites throughout major river basins to assess and characterize the overall water quality and biological integrity. Sites selection will focus on all streams within the targeted river basin. Sampling will be performed during the seasonal low-flow time frame (July-October) and conducted simultaneously with various program areas. Data to be collected and assessed are: water, sediment, and fish tissue samples for laboratory analysis, in-situ water chemistry, stream flow and channel morphology data, fish community assessments, and habitat assessment. The results of this program will further contribute to the Indiana 305(b) Report and subsequent section 303(d) list of impaired streams, the Indiana Fish Consumption Advisory, as well as provide for support of the Environmental Performance Partnership Agreement (EnPPA) and the development of biocriteria for Indiana's surface waters.

P Fish Community Sampling Program

The objective of this program is to assess water quality using resident fish communities as a tool for monitoring the biological integrity of streams. This type of monitoring aids in the classification of streams that exhibit very poor to excellent water quality conditions as well as habitat availability and quality. Because most fish have a life span of greater than three years, fish

community monitoring can detect areas of degradation that have occurred over an extended period of time.

P Fish Tissue Contaminant Monitoring Program

The object of this program is to provide information on chemical contaminants that may be accumulating in the tissues and edible portions of fish tissue. This type of monitoring helps to locate sources of contaminants whose concentrations in water or sediments may be too low to be easily found with normal sampling and laboratory procedures. See Figure 4 for a listing of national CORE network stations in Indiana that provide baseline fish tissue data. The Fish Tissue Contaminant Monitoring Program provides the majority of data used for Indiana's Fish Consumption Advisory for the protection of sport and subsistence fishers; wildlife health risk assessment for fish-eating birds, mammals and reptiles; and information needed to develop models to assess changes in Indiana waters that affect aquatic life and human health.

P Sediment Contaminant Monitoring Program

The object of this program is to provide information on chemical contaminants that may be accumulating in the sediments of Indiana's streams, rivers, and lakes. Sediment monitoring can be an important tool for detecting pollutants in streams and lakes. This type of monitoring helps to locate sources of contaminants whose concentrations in water may be too low to be easily found with routine sampling procedures. The sediment contaminant monitoring program provides supportive information for the fish contaminant monitoring program, wildlife health risk assessments, and for possible future development of models to assess changes in Indiana waters that affect aquatic life and human health.

P Macroinvertebrate Sampling Program

This program is a continuation of the monitoring and assessment of benthic aquatic macroinvertebrate communities of Indiana rivers and streams which began in 1990. Macroinvertebrate community assessment data has been established to evaluate the compositional, structural and functional integrity of the community. Concurrent aquatic habitat assessments are conducted to determine if either site specific habitat degradation or water quality causes can be determined. Monitoring will be conducted through the "revisiting" of randomly selected site locations which were sampled from 1990 through 1996. Additional monitoring efforts are also being developed in conjunction with the watershed monitoring program.

P Lakes

The objective of this program is to provide basic information on the status and trends of the eutrophication (nutrient enrichment) levels of Indiana's public lakes and reservoirs. Physical, chemical, and biological data gathered on each lake are combined into a multi-metric index. This

program is currently being funded with a federal grant administered by IDEM's Office of Water Management. Since 1989 the sampling and analytical efforts for this program have been conducted for IDEM by the staff and students of Indiana University's School of Public and Environmental Affairs (IU/SPEA).

P Permits Support

This activity will provide site specific data needed to develop wasteload allocations for NPDES permits. Other permit support work may be conducted as needed. The data for wasteload allocations may include background concentrations, time-of-travel measurements, sediment oxygen demand and other sampling or measurements as required. Annual prioritized lists of data needs will be provided to the Surveys Section from the Permitting Branch.

P TMDL Support

This activity will involve the identification of impairment activities and the same type of sampling and measurements as mentioned for wasteload allocations. Follow-up sampling may also be required for some TMDLs after control measures have been implemented.

P Identification of Impairments

Water quality standards violations with no identifiable source are often found through sampling programs. This special project will identify impairment activities.

P Other Projects

This activity will involve special work that arises on occasion and requires the expertise of the Assessment Branch. One example is the Trace Metals Pilot Project which will develop sampling techniques for acquiring and analyzing surface water samples for trace metals, both dissolved and total recoverable metals at nanogram per liter levels. Recently, Indiana adopted the Great Lakes Initiative (GLI) water quality standards for watersheds in the Great Lakes Basin. Data showing low level dissolved metals are required to assess these waters. Historically, only total recoverable metals have been monitored and methods or expertise for sampling and analyzing dissolved metals at trace levels have been limited. This project will help IDEM with developing the necessary techniques to sample and analyze toxic metals and their monitoring at trace levels in the surface waters of the Great Lakes Basin.

Figure 3. Summary of Existing Surface Water Quality Monitoring Strategy Sampling Programs

Program	Locations	Assessment
Fixed Station Sampling Program	Sample at main stems of major rivers throughout the State	Stream conditions at high flow, low flow, before agricultural activity, after fertilizer/pesticide application, and seasonal variability. Data used for historical information and trends.
Pesticide Monitoring Program	U.S.G.S. gaging stations within the targeted river basin	Determine ambient concentrations of pesticides and calculate loadings.
Bacteriological Sampling Project	Site selection based on information provided by conservation officers and county health departments	Study used as indicator to show the ability of a water body to support recreational uses for full body contact.
Watershed Monitoring Program*	Sample all streams within the targeted river basin	Water chemistry, sediment, fish community, fish tissue, stream flow, and habitat assessment.
Fish Community Sampling Program	Sample all streams within the targeted river basin	Monitor biological integrity of streams.
Fish Tissue Contaminant Monitoring Program	Sample all streams within the targeted river basin	Study accumulation of chemical contaminants in fish tissues.
Sediment Contaminant Monitoring Program	Sample all streams within the targeted river basin (also includes rivers and lakes)	Study accumulation of chemical contaminants in the sediments of streams, rivers and lakes.
Lakes	Indiana's public lakes and reservoirs	Physical, chemical, and biological data gathered on each lake are combined into a multi-metric index
Macroinvertebrate Sampling Program	Revisiting reference site locations selected from 1990 through 1996 and historical locations of impairment.	Evaluate the compositional, structural and functional integrity of the community. Concurrent aquatic habitat assessments conducted if either site specific habitat degradation or water quality issues causes can be determined.
Special Projects	Based on characteristics of individual study; source water protection	Assessments are based on the special needs of individual projects, such as drinking water
Permits Support	NPDES permitted facilities	Site specific sampling and data collection to develop wasteload allocations for NPDES permits.
TMDL Support	303(d) listed streams	Identification of sources of impairment based; site specific sampling and data collection to develop TMDLs
Source Identification	Impaired stream segments or waterbodies	Identification of sources of impairment in water body with water quality standard violations.
Other Projects	Unique projects such as the Trace Metals Pilot Project	Special work that occasionally arises and requires the expertise of the OWM Assessment Branch.

* formerly referred to as Probabilistic Sampling Program

Figure 4 Fish Tissue Sampling Schedule for CORE Network Stations.*

Wabash River above Lafayette (WB-316)	Maumee River at New Haven (M-129)
Wabash River below Lafayette (WB-303)	St. Joseph River at Bristol (SJR-87)
Wabash River above Terre Haute (WB-218)	St. Joseph River at South Bend (SJR-51)
Wabash River below Terre Haute (WB-183)	St. Joseph River at Fort Wayne (STJ-0.5)
Wabash River at New Harmony (WB-52)	Kankakee River at Kingbury (KR-118)
Wabash River at Bluffton (WB-426)	Kankakee River at IN-IL State Line (KR-68)
White River at Winchester (WR-348)	Indiana Harbor Ship Canal (IHC-1)
White River at Indianapolis Water Canal (IWC-9)	**Lake Michigan off of Michigan City (LM-M)
White River at Waverly (WR-210)	**Lake Michigan off of Whiting (LM-W)
White River at Petersburg (WR-46)	St. Mary's River at Fort Wayne (STM-0.2)
East Fork White River at Williams (EW-79)	Burns Ditch (BD-1)
	Trail Creek at Michigan City (TC-0.5)

* These 23 stations are sampled for fish tissue in conjunction with US EPA's CORE monitoring network of national stations. Sampling is performed once in five years, as a minimum, based on the rotating river basin schedule.

**Samples collected by the Indiana Department of Natural Resources

Source: IDEM, 1986 Fixed Station Water Quality Monitoring Program

C. Suggestions for Future Studies and Actions

There are other water quality monitoring efforts being conducted in the State of Indiana. These include both short-term and long-term endeavors conducted by a variety of entities, such as the Indiana Department of Natural Resources, U.S. Geological Services, local agencies like the City of Muncie's Bureau of Water Quality, or other monitoring conducted by volunteers who are not formally associated with a state program.

The items listed below should be considered when making updates to the *Strategy* in the future.

1. Write and sign a new Memorandum of Understanding for laboratory services performed by the Indiana Department of Health for the Fixed Station Sampling Program.
2. Incorporate studies of lakes, reservoirs, and other lentic waterbodies as well as their tributaries and their outflows where appropriate. The IDEM Lake Water Quality Assessment Program contractor, Indiana University, has already started to shift their sampling schedule to the *Strategy's* rotating basin cycle. Develop statewide database of lake information.
3. Incorporate wetlands monitoring and water quality assessments by both professionals and volunteers.
4. Address main stem Ohio River and Lake Michigan issues, such as atmospheric deposition.
5. Increase emphasis on sampling of surface water supplies for drinking water source water protection³.
6. Expand pesticide monitoring program from the one-year basin study area to a state-wide network of sampling sites.
7. Conduct sampling at confined feeding, land application, and construction sites to assess the water quality impacts of these activities.
8. Increase coordination and assistance to volunteer monitoring programs throughout the state.
9. Increase coordination and collaboration with the Office of Water Management.

³ Source water protection is part of the federal mandate contained in the 1996 Amendments to the Safe Drinking Water Act.

Even the best and most dynamic monitoring program would have difficulty assessing all aspects of aquatic environments. Scientists and ecologists are continually adding to our knowledge of these diverse systems; meanwhile, agency resources must be effectively scrutinized to ensure all forms of pollution are adequately monitored and addressed. Future success in making adequate judgements about the quality of Indiana's surface waters depends on proper application and coordination of staff and equipment and the financial and technical resources available to support the assessment process. These water quality assessments are curcial to the protection and restoration of Indiana's vital water resources.

D. Reporting

The OWM's Assessment Branch has defined *reporting* as:

The component of the monitoring strategy which is the result of the sampling process and includes data management (data entry, maintenance, data documentation and database access), interpretation, publication, and communication of data and information products.

Reporting is identified as one of the major components for an effective monitoring program. The reporting component of the *Strategy* includes but is not limited to:

- P** Indiana Water Quality Report use attainment for Section 305(b);
- P** Technical surface water quality reports;
- P** NPDES permit support;
- P** Develop environmental indicators in support of EnPPA Strategic Goals;
- P** Inter- and intra- governmental data transfer;
- P** Use of Geographical Information System (GIS) tools where appropriate;
- P** Participation in technical and informational publications;
- P** Public information sharing including the Internet;
- P** Presentation of assessments at professional scientific group meetings; and
- P** Public outreach.

All communications will depend on a complete and comprehensive, scientifically defensible information base of which the data meets known and designated data quality objectives for each project and which facilitates data evaluation, data sharing, and information publication.

The Assessment Branch will continue to provide and improve data and information access. Several quality data, information management, and reporting steps have been taken relative to current computer related efforts occurring within the Assessment Branch. The agency has instituted a hardware, networking, and software platform that is used throughout IDEM. Specialized equipment and software have been acquired to address needs specific to

accomplishing the goal of surface water quality assessment. These include the use of Geographic Information Systems (GIS), Geographic Positioning Systems (GPS), and statistical tools. The GIS and GPS tools make it easier to link our sampling data to geographic coordinates using IDEM and national standards for geographic accuracy and precision. Through the use of GIS and GPS the Assessment Branch can provide better information to end-users in a format that is easily communicated (e.g., multi-layer data maps). Spatial and trends analysis tools such as GIS, GPS, and statistical software will aid the Assessment Branch in evaluating and assessing surface water quality. In addition, the Assessment Branch is working on the development of an integrated data management system to improve overall data quality and ease of access.

Additional steps have been identified that will demonstrate a commitment to producing quality end products for this program. These include the development of procedures and formats for:

- P Data entry and standards for quality checks for overall data quality assessment;
- P Data quality objectives (DQOs) to define precision and accuracy of results;
- P Data and information dissemination and related documentation;
- P Data reduction (scores and other metrics as environmental indicators); and
- P Standards for use of data in reports (using known DQOs for each project).

The Assessment Branch will continue to explore the various tools and media available for information development and communication. These include hard copy and electronic publications, public presentations, and the Internet. While the *Strategy* calls for a holistic basin based approach to ambient surface water quality monitoring, it also requires a commitment to improving capabilities in data management and information access. This includes data and information sharing at many different levels including the review of raw data; data analysis and assessment; and recommendations to management for policy decision making. Reporting will be addressed through both customer requests and the basin monitoring strategy.

All fixed station monitoring program data are available for statistical analyses using STORET. STORET (Storage & Retrieval) is an electronic database system maintained in conjunction with US EPA that serves as a central repository for water quality data collected by contributing agencies and organizations. This national water quality database provides analysts opportunities to examine temporal changes in water chemistry for a wide range of parameters throughout the nation's watersheds. STORET plays a vital role in the operational aspects of our water pollution control programs and assists IDEM in compliance with reporting requirements of PL 92-500. (Clean Water Act).

The success of the *Strategy's* data management and reporting is critical to achieving the goals of the monitoring strategy. The *Strategy* will provide comprehensive assessment reports which will fill in the information gaps for which this proactive strategy has been designed.

III. Resources

A. Staff and Financial Resources

When the 1995 *Strategy* was prepared, the Assessment Branch had 24 staff, consisting of 20 full-time employees and 4 temporaries. Currently 28 full-time positions are funded by EPA grants and by the new water permit fees. Nine positions from the Governor's Public Service Summer Internship Program have been requested for May through August 1998 to assist with the summer sampling workload. IDEM has also requested a change in duty assignment for an aquatic ecologist from the U.S. Environmental Protection Agency Region 5 offices.

These new positions with increased funding for analytical chemistry contract lab support were to upgrade the Assessment Branch program activities so that it could support the present and upcoming needs of the NPDES permits, section 305(b) reporting, section 303(d) listing, wasteload allocation and total maximum daily load (TMDL) modeling, nonpoint source programs, and the first Environmental Performance Partnership Agreement (EnPPA) between IDEM and the U.S. EPA.

As shown in Figure 5, IDEM has budgeted a total of \$1,269,140 for contractual services and payments for the surface water quality sampling program.. Of this, \$176,000 of contract funds are for fish tissue and sediment contaminant analyses; \$390,000 in contract funds for water, effluent, and sediment chemical analyses; \$117,750 for pesticide sampling analysis; \$62,890 for gaging station support and \$110,000 for *E. coli* sample collection and analysis contract by the U.S. Geological Survey. The laboratory

bacteriological and chemistry support for the fixed station monitoring program provided by the Indiana State Department of Health currently is performed at no cost to IDEM⁴. There is also a \$65,000 per year contract (nonpoint source funds) with Indiana University for operating the Clean Lakes Program which includes the sampling of 75 public lakes per year for a variety of

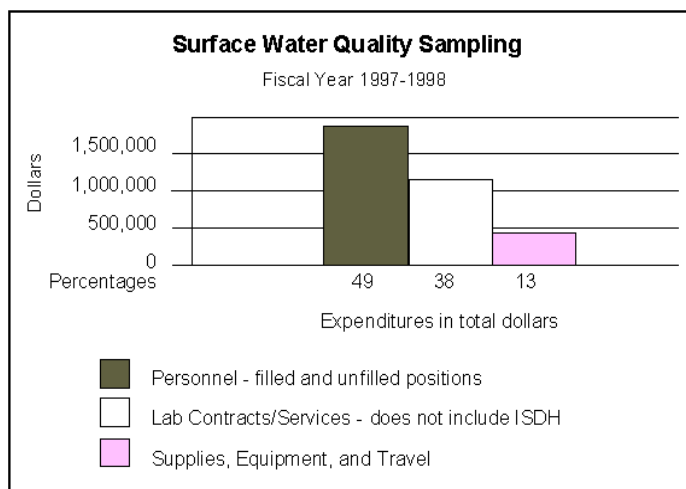


Figure 5

⁴

Based on 1995 estimates, the value of the laboratory services performed by the Indiana Department of Health is approximately \$300,000.

water quality parameters and operating the Indiana Volunteer Lake Monitoring Program and a \$47,500 per year contract with the Indiana Department of Natural Resources for staff to support the Hoosier (i.e., Indiana) Riverwatch Program. The remaining funds are for Special Projects. These funding levels and laboratory support resources should be adequate for the revised *Strategy*.

B. Volunteer Monitoring

Volunteer monitoring has the potential to become an integral part of the *Strategy* if volunteer program coordinators make an effort to focus on the quality of the data that their volunteers are collecting. Throughout Indiana, volunteers are actively collecting data on our rivers and lakes. However, the main focus of most volunteer monitoring programs around the state are improving river and lake stewardship and educating citizens about river and lake ecology and the relationship between land use and water quality.

Making the aforementioned items the only focus of volunteer monitoring programs diminishes the time spent explaining quality assurance (QA) and quality control (QC) steps necessary for producing data of known quality. Additionally, volunteer monitoring programs must focus on collecting high quality, usable data that can be easily accessed and reviewed by professional scientists.

There are approximately 70 organizations and citizens groups throughout Indiana who have declared their concern for the water quality. Many of these organizations have joined efforts to form CRAWDAD (Collaborative Resource Alliance for Water Quality Data and Development) with the goals to promote water education, coordinate water quality data collection and distribution, and to analyze and interpret volunteer data. To date the committee has standardized data collection forms and has made volunteer data in a computerized Internet accessible database. However, the majority of data being collected lacks a sufficient QA/QC plan to ensure the volunteers are collecting and reporting the best data possible. Also, *River Bank*, CRAWDAD's Internet accessible database lacks the ability to enter lake data, and does not include basic information that is needed to routinely compare the volunteer data to IDEM's professional data. IDEM could make use of volunteer data if minor changes are made to the data collection forms, extra steps are taken by the volunteers while collecting data and filling out data sheets, and if the individual(s) entering data into databases take the appropriate steps to ensure quality duplication.

It is possible for a volunteer monitoring programs to collection and report high quality data. IDEM already utilizes data from The Indiana Volunteer Lake monitoring Program for trends and early warning signs. The Indiana Volunteer Lake monitoring program has been collecting high quality data since its inception in 1989, because collecting quality, usable data were primary goal for developing the program. The key to the success of this program's data collection efforts are the personalized training on location at the volunteer's lake, dedication by the volunteers, and that the volunteers do not conduct water chemistry tests at the monitoring site. Volunteers are

trained to properly take water column clarity readings with a secchi disk and collect water samples for professionals to conduct chemical tests. The volunteers send their clarity readings and water samples to Indiana University-School of Public and Environmental Affairs (IU-SPEA) for testing. The program coordinator, assisted by IU-SPEA graduate students, run the chemical tests with proper QA/QC, which greatly increases the accuracy and usability of the results by IDEM.

Because extra steps often mean major changes for some volunteer programs, IDEM's *Strategy* will utilize the strengths of the volunteer programs: outreach, education, and communication with the public. IDEM scientists will need to communicate more often with the volunteer monitoring coordinators and with CRAWDAD, so active volunteers are informed when IDEM scientists will be collecting data in their area. Some volunteer groups may want to observe professionals collecting data, which has the potential to motivate volunteers to make the effort and find the time to improve the quality of their data collection. Also, when IDEM scientists attend volunteer monitoring training sessions or workshops as participants or as guest speakers, they let volunteers know that their efforts are important to IDEM.

IV. Summary and Discussion

The purpose of Office of Water Management's Surface Water Quality Monitoring Strategy (the *Strategy*) is to direct the surface water quality assessment of Indiana's rivers, streams, and lakes for designated water uses. The *Strategy* can also be used as a tool to accomplish the overarching goal of improving the services provided by the Office of Water Management (OWM). The *Strategy* can initiate discussion to improve coordination and collaboration within the Office of Water Management.

Through the utilization of the *Strategy*'s five year rotation study cycle, IDEM accomplishes many things. First, it provides IDEM with the first spatially complete survey of the State's surface water quality, by the year 2001. Second, it provides additional opportunities to interact with the public in the assessment of our state's water resources. This has been evidenced by increased public interest⁵. For many, it represents the first time IDEM has been in a local area and provides an opportunity for public interaction on general water quality issues. Third, it provides an opportunity to improve coordination with other state and federal programs involved in water quality issues.

⁵ Brochures are distributed prior to and during the basin sampling surveys to explain the purpose of the surveys and to provide contact information. IDEM field staff have had very positive feedback from the farmers, governmental representatives, and local area residents during the course of collecting samples.

The *Strategy* should be used to develop a holistic plan for addressing and prioritizing water quality issues and to improve the inter-relationship of the various OWM programs. These federal/state programs have been introduced independent of each other. The *Strategy* should help focus the use of our resources and to reduce both duplication of effort and information gaps. The *Strategy* is but one example of the interaction of different program areas to work together to collect the data needed in support of the biennial 305(b) Water Quality Report, National Pollutant Discharge Elimination System (NPDES) permitting program, annual Fish Consumption Advisory⁶, and drinking water source protection of the SDWA (1996).

During planning discussions, OWM plans to make a greater commitment to data analysis and assessment. In the past, IDEM has only had sufficient resources to collect or process primary sources of data (samples, permits, or inspections) with limited time and available electronic resources for in-depth analysis and assessment of the data both within a program area and across program areas. The information produced from in-depth analysis and assessment is needed and most often requested by businesses, organizations and the general public. The *Strategy* can be used as a framework for optimizing resources to provide better analysis and assessment of water quality in Indiana.

⁶ The Fish Consumption Advisory is produced in conjunction with Indiana Departments of Health and Natural Resources

Appendix A

Fact Sheets

Fact Sheets

The following fact sheets were developed and written to describe to the public the different types of activities IDEM conducts in the research, analysis, and assessment of the quality of Indiana's surface waters.

Document ID#	Title
IDEM 32/01/001	Watershed Monitoring Program*
IDEM 32/01/002	Pesticide Monitoring Program
IDEM 32/01/003	Environmental Toxicology and Chemistry Section
IDEM 32/01/004	Fish Community Sampling Program
IDEM 32/01/005	Fish Tissue Contaminant Monitoring Program
IDEM 32/01/006	Biological Studies Section
IDEM 32/01/007	Macroinvertebrate Community Assessment Program
IDEM 32/01/008	Sediment Contaminant Monitoring Program
IDEM 32/01/009	Lake Water Quality Assessment
IDEM 32/01/012	Fixed Station Sampling Program
IDEM 32/01/014	Assessment Branch
IDEM 32/01/015	Surveys Section
IDEM 32/01/016	Surface Water Quality Monitoring Strategy (fact sheet)
IDEM 32/01/017	Synoptic Sampling Program
IDEM 32/01/018	Total Maximum Daily Load(TMDL) Program
IDEM 32/01/019	<i>E. coli</i> Monitoring Program

* formerly known as the *1998 Probability Based Sampling Program* fact sheet



IDEM's Surface Water Quality Assessment Program

Watershed Monitoring Program

[Previously known as: *1998 Probability Based Sampling Program* fact sheet]

Program Objective

This program uses a statistically valid number of randomly selected sites throughout major river basins to assess and characterize the overall water quality and biological integrity. Sites selection will focus on all streams within the targeted river basin. Sampling will be performed during the late-Spring to early-Fall time frame (May-October) and conducted simultaneously with various program areas. Data to be collected and assessed are: water chemistry, and fish tissue samples for laboratory analysis, in-situ water chemistry, channel morphology data, fish community assessments, and habitat assessment. The results of this program will further contribute to the Indiana 305(b) Report and subsequent section 303(d) list of impaired streams, the Indiana Fish Consumption Advisory, as well as provide for support of the Environmental Performance Partnership Agreement (EnPPA) and the development of biocriteria for Indiana's surface waters.

Program Participants

This program will be achieved by the cooperative sampling efforts of the Surveys and Biological Studies Sections of the Assessment Branch, and through support of the U.S. EPA Research Laboratory in Corvallis, Oregon.

Program Description

Media:	Surface Water; rivers, streams and lakes
Study Area:	Statewide (in targeted basins based on a five year rotating basin cycle)
Site Selection Type:	Probability-based sampling sites are selected by a representative, stratified random draw.
Sampling Sites:	A minimum of 38 sites within the targeted basins.
Sampling Frequency:	Water chemistry to be sampled three times during sampling time frame. Biological sites to be sampled once during sampling time frame.
Data Collected:	Water Chemistry, Fish Tissue, Fish Community Assessment, and Habitat Evaluations

Program Product(s)

- ▶ Report: Great Lakes and Ohio River Tributary Sampling Sites and Stream Standard Violations, Report for the 305(b) Coordinator
- ▶ Report: Statistical Analysis by Basin and Ecoregions of the Water Chemistry Analytes in Great Lake and Ohio River Tributaries
- ▶ Report: Assessment of the Fish Communities of the Great Lakes and Ohio River Tributaries.

Technical Notes

WATER CHEMISTRY PARAMETERS		
PRIORITY METALS	ANIONS/PHYSICAL	NUTRIENTS/ORGANICS
Arsenic	Alkalinity	TKN
Cadmium	Total Solids	Ammonia-N
Chrome(III)	Suspended Solids	Nitrate-Nitrite-N
Copper	Dissolved Solids	Total Phosphorus
Lead	Sulfate	TOC
Mercury	Chloride	Cyanide-Total
Nickel	Hardness	Cyanide-Free
Selenium		COD
Zinc		

FISH TISSUE PARAMETERS			
GENERAL	PESTICIDES	PCB'S	METALS
% Moisture	Pesticides	Total PCB's	Mercury
% Lipids			Cadmium
			Lead

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EnviroLine: (317) 232-8603 or 800-451-6027 toll-free for Indiana residents	Permitting and Compliance Branch (NPDES permits, Inspections, operator assistance, and compliance.) Indiana Government Center North, Indianapolis (317) 232-8675
Fax on Demand: 800-726-8000	Drinking Water Branch (Public water supply and ground water protection) Shadeland Office, Indianapolis (317) 308-3280
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IDEM's Surface Water Quality Assessment Program

Pesticide Monitoring Program

Program Objective

The objective of this project is to determine the ambient concentrations of pesticides in the surface waters in Indiana. Loadings are also calculated based on flow data obtained from U.S. Geological Survey (USGS) gaging stations. This data will provide benchmark information for long-term trend analysis along with a broad scale overview of water quality. IDEM will gain a better understanding of pesticide concentration loads each watershed contributes to each major water basin.

Program Participants

This program is operated through the sampling efforts of the Office of Water Management's Assessment Branch and the lab analysis of Environmental Health Laboratory (EHL) located in South Bend, Indiana.

Program Description

Media:	Surface Water: rivers, streams and lakes
Study Area:	Statewide by the year 2001
Site Selection Type:	Sites selected at USGS gaging stations
Sampling Sites:	23 sites in the Great Lakes and Ohio River Tributaries.
Sampling Frequency:	Preliminary survey in late March then 15 consecutive weeks during April-August
Data Collected:	pesticides

Program Product(s)

- ▶ Report: *Concentrations of Pesticides in the Surface Water of the Great Lakes and Ohio River Tributaries.*

Technical Notes

- ▶ Test for 226 water soluble herbicides, pesticides and semi-volatile compounds using the EPA Method 525.2 and 555 at Data Quality Level 3. List of pesticides tested available upon request.
- ▶ Collect field results for temperature, pH, dissolved oxygen, conductivity, and turbidity.

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IDEM's Surface Water Quality Assessment Program

Environmental Toxicology and Chemistry Section

Program Objective

The Environmental Toxicology and Chemistry Section (ETCS) provides technical and liaison services within the Office of Water Management (OWM) in the areas of general and environmental toxicology, toxicity evaluation and risk assessment analysis, quality assurance of environmental sampling and analytical data results from analysis of environmental samples. The Section as part of the Assessment Branch Water Quality Monitoring activities, also leads efforts on developing TMDLs (Total Maximum Daily Loads) for Impaired Waterbodies that are on the 303(d) List. Broadly speaking, the ETCS staff provides information regarding the current and future impact of various pollutants and toxic substances on aquatic life, human health and the environment. Quality assurance support is provided to various programs within the **Assessment Branch** and across OWM for analytical data collected to meet individual project objectives. The main mission and objectives of the ETCS are:

- ! Assure that State Water Quality Criteria (WQC) or standards are implemented through the of NPDES (National Pollutant Discharge Elimination System) permit limit compliance monitoring program to improve and maintain surface water quality and its designated uses. Regular and timely review of the pollutant monitoring data and toxicity biomonitoring reports submitted by the regulated community serves as a basis to accomplish this goal.
- ! Assess the potential for exposure and toxic effects of chemical pollutants or toxicants from environmental media (water, soil, sediments and fish tissue) and their release into the environment through point or nonpoint source discharges. This information is made available to management and other customers, both within and outside IDEM, to prevent further environmental pollution and improve both water quality and the environment.
- ! The TMDL development is required of the impaired waterbodies that do not meet the water quality standards. The TMDL work involves characterization and identification of the target parameters and their risk to human health or aquatic life, identifying sources of pollution and quantification of loading, and calculation of Load Allocation (LA) and Waste Load Allocation (WLA) for the non-point and point sources. Implementation of TMDL through point and non-point source programs is expected to achieve an overall improvement in water quality of an impaired waterbody in a particular Watershed.
- ! Provide quality assurance support to Assessment Branch data collection efforts and analysis of environmental samples (water, sediments, and fish tissue) through compliance with the integrated Quality Assurance Project Plan (QAPP) prepared for surface water toxics monitoring programs. This work is performed not only to ascertain quality and accuracy of environmental data collected but to ensure that the analytical data gathered are of high quality and can be used with confidence in assessing surface water quality.

Program Participants

This program is operated through the sampling efforts of the Office of Water Management's Assessment Branch (Biological Studies and Survey sections), the Permit Branch (NPDES program), and the Operations Branch (Data Management Section). Also coordinates with the Indiana Department of Health (ISDH) Environmental Lab and Contract Laboratories for laboratory analysis of environmental samples, data collection and data review process.

Program Description

Media:	Surface Water: rivers, streams and lakes
Study Area:	statewide
Site Selection Type:	B not applicable
Sampling Sites:	B not applicable
Sampling Frequency:	B not applicable
Data Collected:	Conduct reviews of water chemistry, bacteriological lab data and reports received from regulated community and contract analytical laboratories.

Program Product(s)

- ▶ *Quality Assurance Project Plan (QAPP) for Indiana Surface Water Programs*
- ▶ *General Guidance for Conducting Biomonitoring Toxicity Tests for Indiana NPDES Permits*
- ▶ *General Procedures for Aquatic Toxicity Testing and Guidelines to Develop Site-Specific Water Quality Criteria*
- ▶ *General Procedures and Guidance for Developing a Metal Translator*
- ▶ *1998 303(d) List of Impaired Waterbodies and 15 year Schedule for TMDL Development*
- ▶ *QA/QC and Toxicity Biomonitoring Review Reports*

Technical Notes

- ▶ Evaluate toxicity biomonitoring reports received from National Pollutant Discharge and Elimination System (NPDES) permittees for Whole Effluent Toxicity Testing (WETT) and prepare the Biomonitoring Review Reports.
- ▶ Evaluate toxic chemicals and/or new products for toxicity and risks to Aquatic Life and Human Health and to recommend for approval or disapproval of their use as pesticides or biocides in Indiana.
- ▶ Develop Water Quality Criteria for the NPDES program for chemicals which have no standards at state or national levels for outside the Great Lakes Basin.
- ▶ Evaluate site-specific study plans and site-specific water quality criteria proposed and developed by the permittees to assure correct water quality criteria are implemented through the NPDES program to protect the Designated Uses of Surface Waters.
- ▶ Evaluate Total versus Dissolved Metal Ratios developed and proposed by the NPDES permittees and to recommend approval or disapproval of their use in Permit Limit Calculations.
- ▶ Evaluate sediments analysis data, sediments toxicity data and develop Interim Sediment Quality Criteria for evaluation and/or remediation of contaminated sediments.
- ▶ Inspect Whole Effluent Toxicity Testing (WETT) Laboratories and Analytical Laboratories for Quality Assurance/Quality Control (QA/QC) compliance.
- ▶ Evaluate analytical contract lab proposals for analysis of environmental samples and make recommendations for selection of contract lab.
- ▶ Prepare and implement Work Plans for conducting sampling, and analysis of water samples for physical, chemical or biological target parameters for the TMDL work.
- ▶ Identify data sources for the existing data for the Impaired Waterbodies that are the 303(d) List and gather all the existing data from water, fish tissues and sediments from appropriate Watersheds for developing the appropriate TMDLs.
- ▶ Prepare presentations for the education and participation of Public and Stakeholders for TMDL development and implementation.
- ▶ Develop TMDLs, both in-house and through contract services, for the non-point and point source discharges using appropriate TMDL models.
- ▶ Conduct quality assurance of analytical data generated from analysis of environmental samples (water, sediments and fish tissue samples) and prepare the QA/QC review reports.

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IDEM's Surface Water Quality Assessment Program

Fish Community Sampling Program

Program Objective

The objective of this program is to assess water quality using resident fish communities as a tool to monitor the biological integrity of a stream. This type of monitoring aids in the classification of streams that exhibit very poor to excellent water quality conditions as well as habitat availability and quality. Because most fish have a life span of greater than three years fish community monitoring can detect areas of degradation that have occurred over an extended period of time. Fish community sampling is an integral part of the Watershed Based Monitoring Program (see the *Watershed Monitoring Program* fact sheet, IDEM 32/01/001/1998 for details on this program).

Program Participants

This program is operated through the efforts of the Biological Studies and Surveys sections, with the aid of the Indiana Department of Natural Resources, and U.S. EPA Region 5. Current site selections are made by the U.S. EPA Research Laboratory, Corvallis, Oregon.

Program Description

Media: Surface waters; rivers, streams and lakes

Study Area: Statewide

Site Selection Type: Various methods; Historically, from bridges that offered easy access to the sampling locations. Areas with obvious degradation were avoided if possible. The focus of study was based on Ecoregions (Omernik). Currently, sites are selected randomly from within major watershed boundaries. An attempt is made to sample all sites within the basin regardless of degradation. The focus of study is based on major watershed's which are delineated by Hydrologic Unit Codes.

Sampling Sites: 50-100 sampling sites per basin.

Sampling Frequency: Once per site, 10 percent (approximately 5-10) of the sites are sampled again within the same year to account for field technique accuracy.

Data Collected: Fish community Index of Biotic Integrity (IBI), habitat information Qualitative Habitat Evaluation Index (QHEI), basic water chemistry.

Program Product(s)

- ▶ Provide information for the Section 305(b) report
- ▶ Support for Section 303(d), list of impaired waters
- ▶ Technical reports on fish community trends and assessments
- ▶ Aid in the development of criteria for biological integrity
- ▶ Support the Environmental Performance Partnership Agreement (EnPPA)

Technical Notes

The Index of Biotic Integrity (IBI) is used to calculate the results of fish community data. The IBI is composed of 12 metrics that assess the communities species and trophic composition (feeding and reproductive guilds) and fish condition and health. The total IBI score, integrity class and attributes help define fish community characteristics (see chart below). When fish community data (IBI) is plotted against habitat data (QHEI) areas of impairment, as well as areas with excellent water quality and habitat become clear.

Total IBI Score	Integrity Class	Attributes
58-60	Excellent	Comparable to pristine conditions, exceptional assemblage of species.
48-52	Good	Decreased species richness, intolerant species in particular: sensitive species present.
40-44	Fair	Intolerant and sensitive species absent; skewed trophic structure.
28-34	Poor	Top carnivores and many expected species absent or rare: omnivores and tolerant species dominant.
12-22	Very Poor	Few species and individuals present; tolerant species dominant; diseased fish frequent.
	No fish	Repeated sampling finds no fish.

Karr et al., 1986.

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IDEM's Surface Water Quality Assessment Program

Fish Tissue Contaminant Monitoring Program

Program Objective

The object of this program is to provide information on chemical contaminants that may be accumulating in the tissues and edible portions of fish. This type of monitoring helps to locate sources of contaminants whose concentrations in other environmental media are often too low to be easily found with simple sampling and laboratory procedures. The fish tissue contaminant monitoring program provides the majority of data used for Indiana's Fish Consumption Advisories for the protection of sport and subsistence fishers; wildlife health risk assessment for fish-eating birds, mammals and reptiles; and finally provides information needed to develop models to assess changes in Indiana waters that affect aquatic life and human health.

Program Participants

This program is operated through the sampling efforts by the Biological Studies Section of the Assessment Branch. Contract laboratory services are utilized for contaminant levels determination. Decisions on fish consumption advisories are made through an Interagency Workgroup consisting of participants from IDEM, the Indiana State Department of Health (ISDH), and the Indiana Department of Natural Resources (IDNR). Fish consumption advisories are issued through the ISDH.

Program Description

Media:	Surface water: rivers, streams, reservoirs and lakes
Study Area:	Statewide
Site Selection Type:	Historically, a targeted site selection based on need for information, follow-up monitoring, or regular biennial revisits. Program is also now implementing a fish tissue collection portion into the probability based sampling program of the Surface Water Monitoring Strategy to better understand basin wide and regional contaminant levels and trends.
Sampling Sites:	Based on a probabilistic draw in wadeable streams (see fact sheet: <i>Watershed Monitoring Program</i>). Continued targeting of sites on larger main stem rivers, lakes, and reservoirs, emerging problem areas of the state, and water bodies never before monitored.
	Sampling Frequency: 5 year basin rotations for entire State (see : http://www.state.in.us/idem/owm/assessbr/master_swqms7.pdf)
Data Collected:	Chemical contaminant levels in fish flesh

As a member of the Ohio River Valley Sanitation Commission (ORSANCO), Indiana contributes in giving ORSANCO the responsibility of monitoring fish tissue contaminants in the Ohio River and the lower reaches of its major tributaries (including the Wabash River).

As a Great Lakes State, Indiana also participates in the annual Great Lakes Fish (tissue) Monitoring Survey sponsored by the U.S. Environmental Protection Agency (U.S. EPA). This is the 20th year of Indiana's participation in this program. In alternating years coho and chinook tissue samples are collected by IDNR and submitted to the U.S. FDA analytical laboratory in Minneapolis, MN.

Beginning in the summer of 2000 Indiana will be a participating State in a National Study of Chemical Residues in Lake Fish Tissue. The U.S. EPA Office of Science and Technology (OST) is coordinating this national effort. It utilizes a probability based survey design (random selection) to select lakes for sampling. Its objective is to estimate the national distribution and extent of the average levels of some of our most common persistent bioaccumulative chemicals in fish tissue from lakes and reservoirs of the continental United States. The design to be used in this study is based on designs developed by the Environmental Monitoring and Assessment Program (EMAP) of U.S. EPA (see: <http://www.epa.gov/emap/>). A number of specific questions will be addressed in the sample design. Field collections for this project are expected to take four years. Indiana has eleven lakes identified for sampling which will be spread over the four years as determined by the sampling design. All laboratory costs will be paid by the U.S. EPA.

Program Product(s)

- ▶ *Indiana's Fish Consumption Advisory.*
- ▶ Use support designations of Indiana waters for Section 305(b) Report
- ▶ Assessments for Section 303(d) List of Impaired Waters in Indiana.
- ▶ Periodic technical reports on contaminant levels and trends.
- ▶ Environmental Indicators development in support of the Environmental Performance Partnership Agreement (EnPPA) between Indiana and U.S. EPA.
- ▶ Support of Indiana's Remedial Action Plan for the Northwest Indiana Area of Concern.
- ▶ Support of the Lake Michigan Lakewide Area Management Plan.
- ▶ Support of the Indiana Lakes Management Work Group.

Technical Notes

Contaminants analyzed for includes a number of metals (23) including cadmium, lead, and mercury, organochlorine pesticides (27) such as DDT, chlordane, and dieldrin, and total polychlorinated biphenyls (PCBs). Additional contaminants such as polycyclic aromatic hydrocarbons (PAHs) (18), semivolatile (47), volatile (33) compounds, congeners of PCBs and dioxins, and tributyl tin may be analyzed for when industrial, municipal, and/or other source pollution is suspected.

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IDEM's Surface Water Quality Assessment Program

Biological Studies Section

Program Objective

The Biological Studies Section (BSS) conducts ecological assessments of Indiana surface waters, providing its customers direct measurement of environmental quality and information on any changes over time of this quality. The assessment of environmental quality involves the direct and indirect measurements of numerous parameters within several media of the environment including: chemical analysis of specific water quality parameters, chemical analysis of surficial aquatic sediments, measurement of fish tissue contamination, acute and chronic toxicity of National Pollution Discharge and Elimination System (NPDES) effluents, aquatic habitat quality, fish community impairment, invertebrate community impairment, and lake eutrophication levels. The role of the BSS relative to these environmental media and the environmental indicators that we provide our customers are outlined in Table I.

The Biological Studies Section conducts studies of fish and macroinvertebrate communities, as well as stream habitats, to establish biological criteria to which all other streams may be compared in order to identify impaired streams or watersheds. This Section also conducts fish tissue and sediment sampling to monitor sources of toxic and bioconcentrating substances whose concentrations are often too low to be detected in other environmental media. Fish tissue data serve as the basis for fish consumption advisories which are issued to protect the health of those who consume fish caught in Indiana waters. Fish tissue data are also useful for wildlife health risk assessments for fish-eating birds and mammals, and for providing the information needed to develop models for assessing changes in the quality of Indiana ecosystems.

The BSS is responsible for determining the biological integrity of aquatic communities of Indiana streams and lakes. This is accomplished through a variety of field and laboratory studies that involve several different forms of aquatic life. These data are used to determine compliance with the existing narrative biological criteria in Indiana's current water quality standards, to determine the extent of ecological harm, and to make correlations to physical and/or chemical impairments which may occur.

The Section also oversees lake monitoring efforts conducted under contract by staff and students of the Indiana University School of Public and Environmental Affairs, as well as by a corps of trained volunteer monitors. Both programs include the monitoring of physical, chemical and/or biological parameters useful in assessing the impacts of nutrients in Indiana lakes and reservoirs.

The BSS participates in the review of requests for site-specific water quality criteria for waters influenced by NPDES discharges. In the course of its various monitoring and assessment field activities the staff finds point- and nonpoint source-related problems which are then referred to the appropriate IDEM programs. The Section also cooperates in monitoring and assessment of the Ohio River in conjunction with the Ohio River Valley Water Sanitation Commission (ORSANCO), and other state and federal agencies.

Table I. Role of the Biological Studies Section Relative to Media and Ecological Data Collected and Expressed in Terms of Environmental Stressors, Responses and Indicators

Chemical, Physical and Biological Stresses	Environmental Responses	Environmental Indicators Used to Assess Impairment
Point Source Pollution and Nonpoint Source Pollution	Elevated Pollutants in Water	Water Chemical Specific Concentrations and Loadings
	Elevated Pollutants in Aquatic Sediments	Sediment Chemical Specific Concentrations and Loadings
	Elevated Pollutants in Fish Tissue	Contaminant Bioconcentration in Fish Tissue, Fish Consumption Advisories
	Acute and Chronic Toxicity	Effluent Toxicity Tests
Destructive Habitat Alterations	Decreased Aquatic Habitat Quality	Aquatic Habitat Evaluation Index
Collective Ecosystem Level Responses to Environmental Stress	Fish Community Impairment	Fish Community Index of Biotic Integrity (IBI)
	Invertebrate Community Impairment	Macroinvertebrate Index of Biotic Integrity (mIBI)
	Lake Eutrophication	Indiana Trophic State Index
		Carlson Trophic State Index

Program Participants

The Section works directly with the other sections of the Assessment Branch including the Surveys Section and the Environmental, Toxicology and Chemistry Section. Work is conducted cooperatively with the Indiana Department of Natural Resources, Indiana State Department of Health, U.S.EPA, U.S. Geological Survey, U.S. Fish & Wildlife Service, U.S. Army Corps of Engineers, ORSANCO, local regulatory agencies, Indiana public and private school students and faculty, and staff and students of numerous state universities and colleges. Internal customers include various programs within IDEM's Offices of Land and Water Quality (OLQ and OWQ, respectively). Ultimate customers are the citizens and of Indiana.

Technical Notes

Please see the technical notes for the fact sheets listed in the Program Products section below.

Program Descriptions

Media:	Surface water; rivers, streams and lakes
Study Area:	Statewide
Site Selection Type:	<i>see fact sheets listed in Program Products section</i>
Sampling Sites:	<i>see fact sheets listed in Program Products section</i>
Sampling Frequency:	<i>see fact sheets listed in Program Products section</i>
Data Collected:	<i>see fact sheets listed in Program Products section</i>

Program Products

- ▶ Fact Sheet: *Fish Community Sampling Program B* IDEM 32/01/004/1998
- ▶ Fact Sheet: *Fish Tissue Contaminant Monitoring Program B* IDEM 32/01/005/1998
- ▶ Fact Sheet: *Sediment Contaminant Monitoring Program B* IDEM 32/01/008/1998
- ▶ Fact Sheet: *Macroinvertebrate Community Assessment Program B* IDEM 32/01/007/1998
- ▶ Fact Sheet: *Lake Monitoring Program -* IDEM 32/01/009/1998

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IDEM's Surface Water Quality Assessment Program

Macroinvertebrate Community Assessment Program

Program Objective

The Biological Studies Section (BSS) conducts biological community assessments of Indiana rivers and streams through the collection, study and assessment of Macroinvertebrate communities (animals without a backbone that can be seen with the naked eye, such as aquatic insects, snails, crayfish, mussels, etc.). Any biological community assessment is a measurement of a collective ecosystem level response to environmental stress and gives an annual picture of the worst conditions which have been imposed on the ecosystem at the point being assessed. When conducted in conjunction with chemical analysis of specific water quality parameters and aquatic habitat quality, they provide a more complete and comprehensive picture of ecological quality of the watershed.

The Biological Studies Section uses these Macroinvertebrate and habitat studies to establish biological standards to which all 35,673 miles of Indiana streams may be compared in order to identify impaired streams or watersheds. These data are used to determine compliance with the existing narrative biological criteria in the Indiana water quality standards, determine the extent of ecological harm, and make correlations to physical and/or chemical impairments which may occur. These data provide the information needed to develop models to assess changes in Indiana ecosystems that affect aquatic life and human health.

In the course of its various monitoring and assessment field activities the staff finds obvious biological impairment due to point and non-point source related problems which are immediately referred to the appropriate IDEM programs. The Biological Studies Section also participates in evaluating Macroinvertebrate monitoring and assessment programs on the Ohio River with the Ohio River Valley Water Sanitation Commission (ORSANCO).

Program Participants

This particular monitoring program is conducted by the staff of the Biological Studies Section of the Assessment Branch. No contractual laboratory services are needed as field samples collected in the field are returned to the BSS Laboratory for enumeration and identification. Data reduction is conducted during the winter months by the section's staff and data are maintained in a sample tracking and relational database format.

Program Description

Media:	Surface water; rivers, streams and lakes
Study Area:	Statewide
Site Selection Type:	Presently 704 different sites on 465 different rivers and streams in Indiana have been sampled. These sites include sites sampled in 84 of the states 92 counties (over 91% of the state). These data represent riffle communities at wadeable stream and river sites and were derived from a study to establish reference conditions.
Sampling Frequency:	Sampling is limited to July-October each year. The fixed station CORE sites are sampled on a rotational basis as part of the OWM Surface Water Monitoring Strategy.
Data Collected:	Benthic Macroinvertebrate community assessment samples are collected by several methods from Indiana rivers and streams. Biological samples are museum curated and maintained for the state. Macroinvertebrate community assessment data evaluating the compositional, structural and functional integrity of the biological community is being established. Concurrent aquatic habitat assessments are conducted to determine if either site specific habitat degradation or water quality causes can be determined. These data are used in determining the baseline reference condition for the calibration of a state wide Macroinvertebrate index of biotic integrity (mIBI) and this is in turn being used in the surface water monitoring strategy of the Office of Water Management.

As a member of the ORSANCO, Indiana contributes in giving ORSANCO the responsibility of monitoring the Macroinvertebrate communities of the Ohio River and the lower reaches of its major tributaries (including the Wabash River). ORSANCO has subcontracted some of these studies to the Ohio Biological Survey and to Universities.

Universities and consulting companies employed by dischargers periodically conduct site or watershed specific Macroinvertebrate community assessments within Indiana lakes rivers and streams.

Program Products

- ▶ Contribution to Indiana's biennial 305b Report
- ▶ Support for 303(d) List of impaired waters in Indiana.
- ▶ Biological Impairment Reports to Inspectors
- ▶ Periodic technical reports on biological watershed assessments and trends
- ▶ Environmental Indicators development to measure success of environmental objectives in support of the Environmental Performance Partnership Agreement (EnPPA) between Indiana and U.S. EPA.
- ▶ Support of Indiana's Remedial Action Plan for the Northwest Indiana Area of Concern.
- ▶ Support the Triennial Review of Indiana Water Quality Standards

Technical Notes

A rapid bioassessment collection is reduced, using a 100 organism sub-sampling method. The sample is then enumerated and identifications of the organisms found within the sample are reduced to ten family level metrics, evaluating the condition of the biological community. These data are in turn reduced to an average multi-metric score for the site and compared to a reference condition.

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IDEM's Surface Water Quality Assessment Program

Sediment Contaminant Monitoring Program

Program Objective

The object of this program is to provide information on chemical contaminants that may be accumulating in the sediments of Indiana's streams, rivers, and lakes. Sediment monitoring can be an important tool for detecting pollutants in streams and lakes. This type of monitoring helps to locate sources of contaminants whose concentrations in other environmental media (such as water) are often too low to be easily found with routine sampling procedures. The sediment contaminant monitoring program provides supportive information for the fish contaminant monitoring program, wildlife health risk assessments, and for possible future development of models to assess changes in Indiana waters that affect aquatic life and human health.

Program Participants

This program is operated through the sampling efforts by the Biological Studies and Surveys Section of the Assessment Branch. Contract laboratory services are utilized for contaminant levels determination.

Program Description

Media: Surface water; rivers, streams and lakes

Study Area: Statewide

Site Selection Type: Historically, a targeted site selection based on need for information, follow-up monitoring, or regular biennial revisits. Collection of sediment samples generally occurs in parallel with the fish tissue contaminant monitoring program.

Sampling Sites: Continued targeting of sites on rivers, lakes, and reservoirs.

Sampling Frequency: 5 year basin rotations for entire State
(see: http://www.state.in.us/idem/owm/assessbr/master_swqms7.pdf)

Data Collected: Chemical contaminant levels in composite grabs of surficial aquatic sediments from river, stream, reservoir and lake sediments. Many of these contaminants analyzed for may bioaccumulate in fish.

Program Product(s)

- ▶ Use support designations of Indiana waters for 305(b) Report
- ▶ Assessments for 303(d) List of Impaired Waters in Indiana.
- ▶ Impairment reports to Inspectors.
- ▶ Periodic technical reports on contaminant levels and trends.
- ▶ Environmental Indicators development in support of the Environmental Performance Partnership Agreement (EnPPA) between Indiana and U.S. EPA.
- ▶ Support of Indiana's Remedial Action Plan for the Northwest Indiana Area of Concern.
- ▶ Support of the Lake Michigan Lakewide Area Management Plan.
- ▶ Support the Triennial Review of Indiana Water Quality Standards

Technical Notes

Contaminants that may be analyzed for includes a number of metals (23) including cadmium, chromium, copper, lead, mercury, nickel, and zinc; organochlorine pesticides (27) such as DDT, chlordane, and dieldrin; and aroclors of polychlorinated biphenyls (PCBs) (8 aroclors). Additional contaminants such as polycyclic aromatic hydrocarbons (PAHs) (18), semivolatile (47), volatile (33) organic compounds, congeners of PCBs and dioxins, and tributyl tin may be analyzed for when industrial, municipal, and/or other source pollution is suspected. Other measurements and analyses include particle size distribution, percent moisture, total organic carbon, total ammonia, and acid volatile sulfide content.

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IDEM's Surface Water Quality Assessment Program

Lake Water Quality Assessment

Program Objective

The objective of this program is to provide basic information on the status and trends of the trophic state (enrichment levels) of Indiana's public lakes and reservoirs. Eutrophication is a natural process of lake aging; the rate of which can be adversely increased by man's activities. Physical, chemical, and biological data gathered on each lake are combined into a multi-metric index commonly known today as the Indiana Trophic State Index (ITSI); a modified version of the BonHomme Index developed for Indiana in 1972. Eutrophy points are assigned to each parameter, then totaled for a final ITSI score ranging from 0 to 75. The lower the score, the lower the levels and effects of nutrients.

A complementary effort of monitoring lakes in Indiana is provided by a corps of citizen volunteers. Volunteers are trained to monitor water clarity, as well as collect samples for the analysis of total phosphorus and chlorophyll *a*. While volunteers do not sample as intensively as the State does during a single sampling event, they do collect data on a regular basis, season after season. Such consistent data gathering can often be quite useful in detecting changes in water quality.

Program Participants

This program is currently being funded with a federal grant administered by IDEM's Office of Water Quality. The lake surveys described here were originally conducted by biologists with the Indiana State Department of Health, who later formed and functioned under the Indiana Department of Environmental Management. Since 1989 the sampling and analytical efforts for this program have been conducted for IDEM by the staff and students of Indiana University's School of Public and Environmental Affairs (IU/SPEA). Citizens enrolled in the Volunteer Monitoring Program take clarity readings on their lakes regularly, as well as collect samples for analysis at the IU/SPEA laboratory.

Program Description

Media:	Surface water; natural lakes and manmade reservoirs
Study Area:	Statewide
Site Selection Type:	State - Deepest point in boat-accessible, public lakes Volunteers - Deepest point in public or private lakes
Sampling Sites:	State - More than 600 Volunteers - Less than 100
Sampling Frequency:	State - Approximately 20% are sampled July and August of each year Volunteers - Nearly 100 % of lakes are sampled regularly from May to October of each year
Data Collected:	Physical, chemical, and biological (plankton) samples

Program Products

- Reported in: *Indiana's 305(b) Water Quality Report to EPA*
(Produced every two years with electronic updates annually)
- Publications: *Indiana Lake Classification System and Management Plan* (Published 1980 & 1986)
Indiana Lake Water Quality Update: 1989-93 (Printed 1996)
Indiana Volunteer Lake Monitoring Program Results for 1989, -1990-91, and -1992-93
(Printed 1990, 1992, & 1994, respectively)
- Newsletter: *Water Column* (Published quarterly since Fall 1988)

Technical Notes

The parameters listed below are collected during most sampling events by the State. Those in **bold** type are used in calculating the Indiana Trophic State Index. Citizens involved with the volunteer monitoring program also monitor the three parameters marked below with an asterisk (*).

WATER QUALITY PARAMETERS		
PHYSICAL	CHEMICAL	BIOLOGICAL
Light Penetration: via Secchi disk *	Total Phosphorous *	Total Plankton Count
Light Transmission: % at 3 foot depth (via photocell)	Soluble Reactive Phosphorous	% Blue-Green Algae
1% Light Level	Organic Nitrogen	Chlorophyll a *
Temperature Profile	Nitrate-Nitrogen	
Alkalinity	Ammonia-Nitrogen	
Conductivity	Dissolved Oxygen: % saturation at 5 foot depth	
Land Use	Dissolved Oxygen: % of water column with at least .1 ppm	
	Dissolved Oxygen Profile	
	pH	

In addition to the efforts listed above, staff with IDEM's Biological Studies Section collect and analyze fish tissue and sediment samples from a handful of Indiana lakes and reservoirs each year. For more information on these programs please see fact sheet numbers IDEM 32/01/005/1998 and IDEM 32/01/008/1998, respectively.

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IDEM's Surface Water Quality Assessment Program

Fixed Station (Ambient) Monitoring Program

Program Objective

The objective of this program is to provide basic information which would reveal water quality trends and provide data for the many existing and prospective users of surface water in Indiana. The program was developed to determine chemical, physical, bacteriological, and biological characteristics of Indiana water under changing conditions. The information has been used in determining background data for certain types of pollutants, such as chlorides and phosphorous; in the development of wasteload allocations and NPDES permits for wastewater treatment plants; for other municipal, industrial, agricultural, and recreational uses; for future pollution abatement activities such as from review of non-point source effects; and in procuring data useful and necessary for securing public action toward the preservation of streams for all beneficial uses.

Program Participants

This program is operated through the sampling efforts by the Survey Section of the IDEM Office of Water Management's Assessment Branch and lab analyses are performed by the Indiana State Department of Health (ISDH) Laboratory.

Program Description

Media:	Surface Water: rivers, streams and lakes
Study Area:	Statewide
Site Selection Type:	network established in 1957
Sampling Sites:	160 fixed stations
Sampling Frequency:	monthly
Data Collected:	Water Chemistry, Bacteriological and Field Analytical Data

Program Product(s)

- ▶ Report: Indiana Water Quality Monitor Station Records: Rivers and Streams
- ▶ Data available in the U.S. EPA **STORET** database

Technical Notes B Parameters vary for each site

WATER CHEMISTRY PARAMETERS			
PRIORITY METALS	SECONDARY METALS	ANIONS/PHYSICAL	OTHER
Arsenic	Calcium	Alkalinity	TKN
Cadmium	Iron	Total Solids	Ammonia
Chromium (Cr ⁺⁶)	Magnesium	Suspended Solids	Nitrate-Nitrite
Total Chromium	Manganese	Dissolved Solids	Total Phosphorus
Copper	Sodium	Fluoride	TOC
Lead	Dissolved Iron	Sulfate	Cyanide
Mercury	Dissolved Manganese	Chloride	BOD
Selenium	Dissolved Copper	Hardness	COD
Nickel	Dissolved Lead	Dissolved Oxygen	E.coli
Zinc	Dissolved Zinc	pH	Dissolved reactive silica
Barium		Specific Conductance	Phenols
Silver		Turbidity	

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IDEM's Surface Water Quality Assessment Program

Assessment Branch

Program Objective

The Water Quality Assessment Branch is responsible for assessing the quality of water in Indiana's surface waters (rivers, streams, and lakes). Virtually every element of the surface water quality management program of IDEM is directly or indirectly related to one or more activities currently carried out by this Branch. The biological and surface water monitoring activities identify stream reaches, watershed basins or segments where physical, chemical and/or biological quality have been or would be impaired by either point or non-point sources.

Program Participants

The Assessment Branch is composed of three sections which work together to collect data and assess the quality in Indiana's surface waters.

1. **Biological Studies Section** conducts fish and macroinvertebrate community studies as well as habitat assessments to establish biological standards to which all other streams may be compared in order to identify impaired streams or watersheds. In addition, this Section conducts fish tissue and sediment sampling to pinpoint sources of toxic and bioconcentrating substances. Fish tissue data serve as the basis for fish consumption advisories which are issued to protect the health of sport and subsistence fishermen. The Section also participates in the development of site-specific water quality standards.
2. **Environmental Toxicity and Chemistry Section** develops sediment criteria, reviews whole effluent toxicity data and reports, evaluates requests for site specific water quality standards, reviews data gathered during investigations of toxic releases to the environment, provides quality assurance review of data collected during field studies and laboratory analyses, reviews sampling plans for compliance with quality assurance project plans, and oversees development of Total Maximum Daily Loads for Impaired Waterbodies that are on the 303(d) list.
3. **Surveys Section** is responsible for sampling and assessing the quality of waterways and determining the effect of approximately 1,800 permitted point sources on receiving streams. They will provide data for models, 305(b) water quality reports and wasteload allocations for NPDES permitting purposes, as well as an assessment of non-point sources.

Program Description

Media: Surface Water: rivers, streams and lakes
Study Area: Statewide
Site Selection Type: see factsheets listed in Program Products section
Sampling Sites: see factsheets listed in Program Products section
Sampling Frequency: see factsheets listed in Program Products section
Data Collected: see factsheets listed in Program Products section

Program Product(s)

- ▶ Report: *Surface Water Quality Monitoring Strategy* - revised, IDEM 32/01/013/1998

Biological Studies Section

- ▶ Fact Sheet: Biological Studies Section, IDEM 32/01/006/1998
- ▶ Fact Sheet: Fish Community Sampling Program, IDEM 32/01/004/1998
- ▶ Fact Sheet: Fish Tissue Contaminant Monitoring Program, IDEM 32/01/005/1998
- ▶ Fact Sheet: Macroinvertebrate Community Assessment Program, IDEM 32/01/007/1998
- ▶ Fact Sheet: Sediment Contaminant Monitoring Program, IDEM 32/01/008/1998

Environmental Toxicology and Chemistry Section

- ▶ Fact Sheet: Environmental Toxicology and Chemistry Section, IDEM 32/01/003/1998
- ▶ Fact Sheet: Total Maximum Daily Loads, IDEM 32/01/018/1999

Surveys Section

- ▶ Fact Sheet: Watershed Monitoring Program, IDEM 32/01/001/1998
- ▶ Fact Sheet: Pesticide Monitoring Program, IDEM 32/01/002/1998
- ▶ Fact Sheet: Fixed Station Sampling Program, IDEM 32/01/012/1998
- ▶ Fact Sheet: E.coli Monitoring Program, IDEM 32/01/019/1999

Technical Notes

Please read the fact sheets listed in the Program Products section.

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IDEM's Surface Water Quality Assessment Program

Surveys Section

Program Objective

The objective of this program is to provide surface water quality and hydrological data required for the assessment of Indiana's surface waters. As part of the *Surface Water Quality Monitoring Strategy*, the Surveys Section is conducting a five year rotating basin sampling plan of the State's ten major watershed's. Information collected will be reviewed by the Environmental Toxicology/Chemistry Section and integrated with data from Biological Studies Section. Information generated through analysis of the surface water quality data will be published in various formats and made available upon request in report form and via the internet to interested parties.

Program Participants

This program is operated by the Surveys Section of the Surface Water Quality Assessment Branch through the cooperative efforts of the Indiana State Department of Health's Water Quality Laboratory and the U.S. Environmental Protection Agency (U.S. EPA). The Surveys Section also utilizes the contract services of the U.S. Geological Survey and various commercial contract laboratories.

Program Description

Media:	Surface Water: rivers, streams and lakes
Study Area:	Statewide
Site Selection Type:	see factsheets listed in Program Products section
Sampling Sites:	see factsheets listed in Program Products section
Sampling Frequency:	see factsheets listed in Program Products section
Data Collected:	see factsheets listed in Program Products section

Program Product(s)

- ▶ Fact sheet: *Watershed Monitoring Program*, IDEM 32/01/001/1998
- ▶ Fact sheet: *Pesticide Monitoring Program*, IDEM 32/01/002/1998
- ▶ Fact sheet: *Fixed Station Sampling Program*, IDEM 32/01/012/1998
- ▶ Fact Sheet: *E. coli Monitoring Program*, IDEM 32/01/019/1999
- ▶ Report: *Water Quality Assessments of the Great Lakes and Ohio River Tributaries for the 305(b) Report*

Program Product(s) B continued

- ▶ Report: *Fourteen Digit Hydrologic Unit Mileage's for the Great Lakes and Ohio River Tributaries*
- ▶ Report: *Watershed Sampling for the Great Lakes and Ohio River Tributaries*

Technical Notes

Please read the fact sheets listed in the Program Products section.

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IDEM's Surface Water Quality Assessment Program

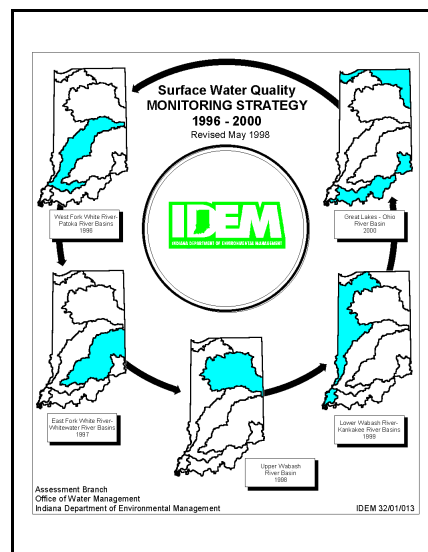
Surface Water Quality Monitoring Strategy

Program Objective

The purpose of Office of Water Management's Surface Water Quality Monitoring Strategy (the *Strategy*) is to direct the assessment of the quality of surface waters of Indiana's rivers, streams, and lakes for designated water uses. The strategy is designed to provide technical data and information in support of the biennial 305(b) Water Quality Report, National Pollutant Discharge Elimination System (NPDES) permitting program, and the annual Fish Consumption Advisory. In addition, the implemented strategy provides water quality information to identify activities responsible for impairment, analyze water quality trends, and develop environmental indicators.

The State is divided geographically into major units for environmental sampling, analysis, and assessment with the goal of completing an initial survey of the State during the five year period of 1996-2000:

- P West Fork White River and Patoka River Basins in 1996;
- P East Fork White River and Whitewater River Basins in 1997;
- P Upper Wabash River Basin in 1998;
- P Lower Wabash River and Kankakee River Basins in 1999; and
- P Great Lakes and Ohio River Basins in 2000.



Data collected from field sampling is analyzed for physical, chemical, and biological factors. For example, specific physical properties of water sampled may indicate a decrease in quality or quantity of habitat in the event of an environmental stress. Specific chemical responses to stress may imply elevated concentrations in fish tissue and sediment. Specific ecosystem factors may result in impaired biological communities.

The Office of Water Management's (OWM) field sampling strategy is designed to describe the overall environmental quality of each basin and to identify impaired water bodies that do not meet water quality standards. Elements of the sampling program include: fixed station monitoring; sampling from statistically selected sites; fish community, fish tissue, and sediment contaminant sampling programs; pesticide monitoring; bacteriological (*E. coli*) sampling; macroinvertebrate sampling; site specific sampling in support of NPDES permitting program; and special projects such as trace metals, Total Maximum Daily Loads (TMDL) sampling, Wildcat Creek Pilot Project, and monitoring of the White River in Marion County.

College students from the Governor's Public Service Internship Program are used each summer to assist the Assessment Branch in field sampling operations. Volunteer monitoring will be employed to supplement existing IDEM staff whenever applicable.

The water quality data will be collected, analyzed, and assessed with information published in multiple formats to be used by a variety of customers. OWM's internal program support activities include: 305 (b) Water Quality Report; 303 (d) Impaired Water Bodies List; TMDL determinations; and NPDES permits. External uses of monitoring data and information include: the annual Fish Consumption Advisory; the IDEM-U.S. EPA Environmental Performance Partnership Agreement; Northwest Indiana Remedial Action Plan; and the Wildcat Creek Watershed Pilot Project. Access to collected data and information will be provided to the public upon request and via the Internet.

Program Participants

This program is operated through the efforts of the OWM Assessment Branch with collaboration with the staff from the Watershed Planning Section (formerly known as the Nonpoint Source Section) and the Permitting Branch. The Fish Consumption Advisory is produced in conjunction with the Indiana Department of Health and the Indiana Department of Natural Resources.

Program Description

Media:	Surface Water: rivers, streams and lakes
Study Area:	Statewide
Site Selection Type:	see fact sheets listed in Program Products section
Sampling Sites:	see fact sheets listed in Program Products section
Sampling Frequency:	see fact sheets listed in Program Products section
Data Collected:	see fact sheets listed in Program Products section

Program Product(s)

- ▶ Report: *Surface Water Quality Monitoring Strategy* - revised, IDEM 32/01/013/1998
- ▶ Fact Sheet: *Assessment Branch*, IDEM 32/01/014/1998

Biological Studies Section

- ▶ Fact Sheet: *Biological Studies Section*, IDEM 32/01/006/1998
- ▶ Fact Sheet: *Fish Community Sampling Program*, IDEM 32/01/004/1998
- ▶ Fact Sheet: *Fish Tissue Contaminant Monitoring Program*, IDEM 32/01/005/1998
- ▶ Fact Sheet: *Macroinvertebrate Community Assessment Program*, IDEM 32/01/007/1998
- ▶ Fact Sheet: *Sediment Contaminant Monitoring Program*, IDEM 32/01/008/1998
- ▶ Fact Sheet: *Lake Water Quality Assessment*, IDEM 32/01/009/1998

Environmental Toxicology and Chemistry Section

- ▶ Fact Sheet: *Environmental Toxicology and Chemistry Section*, IDEM 32/01/003/1998
- ▶ Fact Sheet: *TMDL Monitoring Program*, IDEM 32/01/018/1999

Program Product(s) B continued

Surveys Section

- ▶ Fact Sheet: *Watershed Monitoring Program*, IDEM 32/01/001/1998
- ▶ Fact Sheet: *Pesticide Monitoring Program*, IDEM 32/01/002/1998
- ▶ Fact Sheet: *Fixed Station Sampling Program*, IDEM 32/01/012/1998
- ▶ Fact Sheet: *Surveys Section*, IDEM 32/01/015/1998
- ▶ Fact Sheet: *Synoptic Sampling Program*, IDEM 32/01/017/1998
- ▶ Fact Sheet: *E. coli Monitoring Program*, IDEM 32/01/019/1999

Technical Notes

Please read the fact sheets listed in the Program Products section.

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IDEM's Surface Water Quality Assessment Program

Synoptic Sampling Program

Program Objective

In 1996, the Surveys Section of the Indiana Department of Environmental Management, Office of Water Management, Assessment Branch initiated synoptic water quality sampling surveys in accordance with its new monitoring strategy. This strategy is described in the Office of Water Management document titled, *Monitoring Strategy 1996-2001*.¹

One of the main objectives of these surveys was to describe the environmental water quality of the surface water resource in these basins and to identify what parts of the watersheds are impacted and exhibit signs of existing or emerging problems. This was primarily accomplished by looking at water quality stream standards and by comparing sub-watersheds to each other.

The sampling site selection criteria are: land use, stream confluences and drainage areas. The samples are collected and analyzed to identify which parts of the watershed exhibit signs of existing or emerging problems. Sampling will be done during the whole range of stream conditions: high flow, low flow; before and after agricultural activities including pesticide applications; and seasonal variations.

Field analyses, visual observations, and laboratory analyses are used to provide indications of pollution and/or impacted water quality. Biological indices and habitat assessment are included to gain a picture of the overall health of the water resource in the watershed.

Program Participants

This program is operated by the Surveys Section of the Water Quality Assessment Branch, with laboratory support from commercial contract laboratories or the Indiana State Department of Health Water Quality Laboratory, or a combination thereof. These support facilities may vary from year to year.

¹

The first two years of the monitoring strategy (1996 and 1997) utilized the Synoptic Sampling Program; however, in 1998 the monitoring strategy was revised. This revision, entitled the *Surface Water Quality Monitoring Strategy*, describes the various sampling programs in which data is collected and used. In 1997, a random (probabilistic) based approach was studied in conjunction with the synoptic program. It was determined that a random-based site selection approach in conjunction with an expanded Fixed Station Sampling Program could yield the same types of data in a more efficient manner. Therefore, the synoptic sampling program was discontinued after 1997 in favor of the random-based approach, which is now called the Watershed Monitoring Program.

Program Description

Media: Surface Water: rivers, streams and lakes

Study Area: Basin being studied, depending on year of the 5-year rotation

Site Selection Type: Best professional judgement.

Sampling Sites: Approximately 100 sites.

Sampling Frequency: Six times per year **B** over all seasons and flow variations

Data Collected-

Field Data: Dissolved oxygen, water temperature, pH, turbidity, conductivity, and stream flow, weather code.

Laboratory Data: Water Chemistry and Bacteriological.

Program Product(s)

- ▶ Fact sheet: *Watershed Monitoring Program*, IDEM 32/01/001/1998
- ▶ Fact sheet: *Pesticide Monitoring Program*. IDEM 32/01/002/1998
- ▶ Fact sheet: *Fixed Station Sampling Program*, IDEM 32/01/012/1998
- ▶ Fact sheet: *Surveys Section*, IDEM 32/01/015/1998
- ▶ Report: *1996 West Fork White River and Patoka River Basins General Aquatic Life and Recreational Use Water Quality Assessments for the 305(b) Report*, IDEM 32/02/014/1997
- ▶ Report: *West Fork White River and Patoka River Basin Eleven Digit Hydrologic Unit Mileages*, IDEM 32/02/015/1997
- ▶ Report: *West Fork White River **B** Patoka Watershed Atlas of Synoptic Sampling Sites for 1996*, IDEM 32/02/017/1997

Technical Notes

Sampling sites for this project were selected in such a way as to give an overall even spatial distribution coverage. Then, each site was evaluated as to its upstream land use. Sites were sampled six times over the year to give seasonal coverage. Basic water quality parameters were chosen to characterize the sites. Flow measurements were made at selected sites and data from the USGS gaging station sites were collected in order to help with the chemical data interpretation. Special sampling methods were followed which are referenced in this report. Samples were tested by contract laboratory. Results were entered in the Surveys Section database. Quality assurance and quality control guidelines were followed throughout the whole process.

Technical Notes B continued**Synoptic 1997 - Parameters and Laboratory Test Methods**

General Chemistry--Water	
Parameter	Test Method
Alkalinity	310
Total Solids	160.3
Suspended Solids	160.2
Dissolved Solids	160.1
Sulfate	375
Chloride	325
Hardness	130.1

Nutrient & Organic Water Chemistry	
Parameter	Test Method
Total Kjeldahl Nitrogen (TKN)	351
Nitrate + Nitrite	353.2
Total Phosphorus	365
TOC	415 or SM5310

Bacteriological	
Parameter	Test Method
<i>E. coli</i>	SM9222

Metals--Water Chemistry	
Parameter	Test Method
Arsenic	200.8
Cadmium	
Chromium	
Copper	
Lead	
Nickel	
Iron	200.7
Zinc	
Mercury	245.2

Field Parameters	
Parameter	Method
Dissolved Oxygen	HydroLab™ Multi-Probe sonde, and Scout 2™ Display Unit.
Temperature °C	
pH	
Conductivity	Calibration Checks by: Winkler field kit Hach Turbidimeter Cole-Parmer pH meter Mercury thermometer
Turbidity	
Weather Codes	
Stream Flow**	USGS gage or Wading

**Designated sites only

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IDEM's Surface Water Quality Assessment Program

Total Maximum Daily Load (TMDL) Program

Program Objective

The objective of this program is to develop and implement Total Maximum Daily Loads (TMDLs) to achieve state water quality standards. Section 303(d) of the Clean Water Act requires the development of TMDLs for waters that the State has identified as being impaired. These TMDLs must be established at levels necessary to attain and maintain the applicable water quality standards for designated uses. To accomplish this, TMDLs will set Waste Load Allocations (WLAs) for point source discharges and a set of specific requirements and best management practices for non-point source abatement of toxic pollutants. In order to implement the TMDL Program, IDEM will characterize parameters of concern and the extent and magnitude of the impairment in a waterbody, develop TMDLs that will ensure the attainment of water quality standards in these impaired waters, and finally implement the TMDLs through point and non-point source programs. The TMDL process for each impaired waterbody will take two to three years and will involve four major steps: Planning, Sampling/Data Collection, Modeling and Implementation. The data collection process will include the compilation and review of existing data, and collection and analysis of additional new data necessary for modeling. The next steps include developing the appropriate models, and implementing the strategies necessary to reduce the pollutant loading from point and non-point sources to achieve water quality standards for designated uses. It is anticipated that the first year will be used in planning and sampling/data collection, the second year for modeling the TMDLs and writing the required reports, and the third year for implementation. Throughout the process, identification of stakeholders, public participation and outreach activities will be important to the successful implementation of the TMDL.

Program Participants

The TMDL Program is operated through the efforts of the Toxicology and Chemistry, Surveys, and Biological Studies Sections of the **Assessment Branch** in coordination with staff from the Watershed Management and Water Quality Standards Sections of the **Planning and Restoration Branch**, and with support from the **Permit Compliance Branch**. Primarily, the Assessment Branch will be responsible for the Planning, Sampling/Data Collection and Modeling aspects of TMDLs, whereas the Permit Compliance Branch and the Planning and Restoration Branch will direct the Implementation aspects through point and non-point source programs. Initially, contractor support will be used for the development of the first TMDLs with the possibility of augmenting future program activities. TMDL development will also be conducted cooperatively with the U.S. Army Corps of Engineers (COE) and the Ohio River Valley Water Sanitation Commission (ORSANCO). Laboratory support comes from the Indiana State Department of Health (ISDH), the U.S. Geological Survey (USGS) as well as the Office of Water Management private contract laboratories.

Program Description

Media:	Surface Water and Sediments: rivers, streams and lakes.
Study Area:	Statewide, select impaired waterbodies and watersheds in a major river basin.
Site Selection Type:	Impaired waterbodies from the 303(d) list. As of 1998, 208 impaired waterbodies in 5 major river basins have been identified for TMDL development.
Sampling Sites:	To be determined by the specific parameter of impairment and locations of impaired waterbodies in a watershed.
Sampling Frequency:	To be determined by the specific parameter of impairment and locations of impaired waterbodies in a watershed. Sampling will be limited to the July through October field season.
Data Collected:	Field Data: pH, temperature, hardness, conductivity, alkalinity, etc. Water Chemistry Data: Parameter of concern in each watershed. Bacteriological Data: <u>E. coli</u>

Program Product(s)

- ▶ Watershed Characterization Report selected for TMDLs.
- ▶ Periodic Interim Technical Reports on development of TMDLs.
- ▶ TMDL Final Reports for each impaired waterbody on the 303(d) list.

Technical Notes

- ▶ Contributions to the Indiana Biennial 305(b) Report.
- ▶ Development of the 303(d) List of Impaired Waterbodies.
- ▶ Development of appropriate steady-state and dynamic models for TMDL development.

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IDEM's Surface Water Quality Assessment Program

***E. coli* Monitoring Program**

Program Objective

The objective of this program is to determine the ambient concentrations of bacterial contamination in the surface waters in Indiana. *E. coli* monitoring can be an important tool for determining the safety of swimming and wading in streams and lakes. This data will provide benchmark information for long-term trend analysis along with a broad scale overview of water quality. IDEM will gain a better understanding of fecal contamination in surface waters in sampled watersheds and how that contaminant affects major water basins.

This type of monitoring helps to locate sources of contaminants which are often diverse and widespread. The *E. coli* monitoring program provides supportive information for the Watershed Monitoring Program, (Fact Sheet IDEM 032/01/001/1998) and for development of models to assess Total Maximum Daily Loads (TMDLs, Fact Sheet IDEM 032/01/018/1999) to nonpoint sources in Indiana public and recreational waters.

The project provides for a mobile laboratory to facilitate *E. coli* testing by eliminating the necessity of transporting samples to distant contract laboratories within a six-hour holding time. A converted van provides IDEM staff with work space containing storage for samples, supplies for Colilert testing, and equipment for collecting, preparing, incubating, reading, and disposing of up to 40 samples per day. The use of the mobile laboratory will allow staff to complete the analyses in the field, thereby increasing the number of tests performed.

Program Participants

This program is operated through the efforts of the following Agencies:

1. Indiana Department of Environmental Management, Office of Water Management, Assessment Branch, Surveys Section
2. United States Geological Survey, Indiana District
3. Indiana State Department of Health Laboratory
4. Interagency Taskforce on *E. coli*
5. Other contract laboratories throughout the state of Indiana

Program Description

Media: Surface Water: rivers, streams and lakes
Study Area: Statewide
Site Selection Type: Sites selected are known recreational and public access areas. Nonpoint sources are surveyed from bridges.
Sampling Sites: Site identification information from: County Health Department survey; in 2000, 100 sites are to be surveyed by the mobile laboratory in the twelve counties in the Great Lakes Basin. 42 sites are to be surveyed by USGS in the Ohio River tributaries. The program will evaluate recreational streams and lakes and areas of local concern influenced by non-point sources.
Sampling Frequency: Each location is sampled five times equally spaced over a 30 day period.
Data Collected: Colony forming units of *Escherichia coli* bacteria per 100 ml of surface water. The program will use Method 9223-SM Enzyme Substrate Coliform Test to derive a Most Probable Number (MPN) from charts provided by the manufacturer.

Program Product(s)

Report: 2000 305(b) Assessment of the Great Lakes and Ohio River tributaries.

In Support of: August 2000 Survey of the Great Lakes and Ohio River tributaries in support of the TMDL program, and support of the Interagency Taskforce on *E. coli*.

Technical Notes

1. Test Method 9223-SM Enzyme Substrate Coliform Test for *E. coli* at Data Quality Level 3.
2. Test Method 9213D-SM for *E. coli* at Data Quality Level 3.
3. Temperature, pH, dissolved oxygen, conductivity, and turbidity analyzed in the field.

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Appendix B

Time Line

Time Line

Each sampling program has a different time line. For the purposes of demonstration, the time line for the Watershed Monitoring Program has been provided to illustrate the process involved. The sampling program begins several months prior to actual sample collection and continues months after the last sample has been collected. A brief description of each element is provided below.

Each of the twelve major sampling programs have similar, but slightly different, time lines. Sampling program time lines average 12-24 months from the planning phase to the report writing phase. It is important to note that the twelve major sampling programs occur **concurrently**.

Example of a Sampling Program Time Line

Program	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.
1. Planning																		
2. Site Selection																		
3. Equipment Maintenance																		
4. Requisitions																		
5. Reconnaissance																		
6. Sample Preparation																		
7. Sample Collection																		
8. Sample Lab Analysis																		
9. Data Entry and Data Validation																		
10. Data Assessment and Data Qualification																		
11. Data Analysis																		
12. Report Writing																		

1. Planning – Review and assessment of prior year's sampling are completed for modifications to the workplan. A workplan is written and approved by staff participating in the basin study.
2. Site Selection – Selection of sites is based on analysis of characteristics of the different surface waters within the basin area to be studied. For example, probability-based site selection is based on stream size and wadeability and performed in conjunction with the EPA Corvallis Laboratory.
3. Equipment Maintenance – Existing equipment is checked for accuracy, repaired (if needed), and calibrated for the next year's work.
4. Requisitions – Requisitions are written and processed for equipment repairs, replacements and new orders. In addition, field and sampling supplies are requisitioned in advance of the full sampling season.

5. Reconnaissance – Survey is conducted to determine actual viability of sites for sampling. For example, to determine whether equipment can be transported to the sites in a safe manner. The overall purpose of reconnaissance survey phase is to determine the types of equipment needed, accessibility, safety, and to obtain landowner permission for access.
6. Sample Preparation – Final checks are made to ensure that all sampling equipment is in good working order and supplies are available for sampling. In addition, staff review all safety protocols, equipment calibration check procedures, and train summer interns and new employees.
7. Sample Collection – Field data and samples are collected at each site according to the procedures established in the workplan. Locational coordinates are also collected through the use of Global Positioning System (GPS) field gear.
8. Sample Lab Analysis – Samples are sent to the proper laboratory for parameters established in the workplan.
9. Data Entry and Data Validation (QC) – Data received from the laboratories is entered into a database system and goes through a series of data entry accuracy and quality checks.
10. Data Assessment and Qualification – Laboratory data is reviewed and data quality flags are attached according to the Quality Assurance Project Plan (QAPP).
11. Data Analysis – Data is analyzed through the use of a variety of quantitative and qualitative analytical tools.
12. Report Writing – Assessment reports are written in a variety of formats for internal and external use.

Appendix C

Acknowledgments

Acknowledgments

Revision of the *Surface Water Quality Monitoring Strategy* involved the work and cooperation of many individuals. Sub-committee members are staff from the OWM Assessment Branch unless otherwise noted. Listed below are the the sub-committees and the names of those who participated on the revision of this document.

Steering Sub-committee

Jan Henley, Assessment Branch Chief (chair)
Art Garceau, Surveys Section Chief
Lee Bridges, Biological Studies Section Chief
Dr. Syed GhiasUdden, Ph.D., Environmental Toxicology and Chemistry Section

Planning Sub-committee

Steve Hall, Surveys Section (chair)
Steve Newhouse, Biological Studies Section
Bryan Hummel, Watershed Management Section (Planning Branch)
Gary Pavich, Industrial Permits Section (Permitting Branch)

Sampling Sub-committee

Mark Holdeman, Surveys Section (chair)
Tony Branam, Biological Studies Section
Todd Davis, Biological Studies Section
Betty Ratcliff, Environmental Toxicology and Chemistry Section
Carol Newhouse, Biological Studies Section
Steve Boswell, Surveys Section
John Elliott, Modelling and Engineering Section (Permitting Branch)

Reporting Sub-committee

Jim Stahl, Biological Studies Section (chair)
Joanna Wood, Surveys Section
Linda Schmidt, Water Quality Standards Section (Planning Branch)
Elizabeth San Miguel, Surveys Section

Volunteer Monitoring Sub-committee

Kathryn Clendenin, Biological Studies Section (chair)
Sean Grady, Surveys Section
Ronda Dufour, Biological Studies Section